



C III f. 49

48268/A





Presented

to

His Royal Highness

Prince Albert

for for for

by

The Author.



A
PRACTICAL TREATISE
ON THE
PREVENTION AND CURE
OF
SMOKY CHIMNEYS;
WITH
AN APPENDIX,
CONTAINING VARIOUS EXTRACTS CONNECTED WITH THE SUBJECT,
AND TESTIMONIALS OF THE AUTHOR'S EXPERIENCE.
BY GEORGE SILVER.

GLASGOW:
BLACKIE & SON, 38, QUEEN STREET;
5, SOUTH COLLEGE STREET, EDINBURGH;
AND 21, WARWICK SQUARE, LONDON.

MDCCCXXXVI.

GLASGOW:
PRINTED BY GEORGE BROOKMAN.



TO THE
NOBLEMEN AND GENTLEMEN
OF THE COUNTIES OF
ABERDEEN, BANFF, AND MORAY.

NOBLEMEN AND GENTLEMEN,

Though I have never taken out my degree at a University, I am a Doctor who has had an extensive practice among you for a period of nearly thirty years. I have not followed in the footsteps of the many Quacks who have appeared, and, pretending to cure *every* distemper, at the same time know nothing concerning the cause or cure of any one disease to which the human frame is subject. My pretensions have been confined to one single malady, and in scarcely one instance in all my practice have I failed in accomplishing a complete cure, though in many cases the patient had been tortured and distracted by *unskilful pretending practitioners*, and given up as incurable before I was called in.

I am now getting old, and must soon “rest from my labours,” but with something of the philanthropy and generosity which imbued Dr Buchan and others, I have written out, and now give to the world, the result of my long experience, and as a mark of gratitude I beg most respectfully to dedicate this production to you, hoping that you may find it useful.

I have the honour to be,
Noblemen and Gentlemen,
Your most obedient,
Humble servant,
GEO. SILVER.

ABERDEEN, AUG., 1836.



P R E F A C E.

THE Author of the following Essay has had long and considerable experience in curing smoky chimneys, having been extensively employed in that line for a period of about thirty years, as will appear from the testimonials inserted in the Appendix, to which he refers for a proof that his practice has not only been long and extensive, but, in most cases, completely successful: and he now presents to the public a digest of those principles of constructing houses and fire-places, which have been his guides; some of which have resulted from his own experience and observation, while he has been indebted for others to various publications. He may acknowledge here, once for all, that in many cases he has merely acted the part of a compiler; while, at the same time, he has adopted nothing of which his own observation does not warrant the approval.

It is impossible to lay down particular rules for the cure of smoky chimneys, except in a very few cases; but it will be easy, by comparing the actual situation, circumstances, and construction of a smoky chimney, to ascertain the cause or causes

of smoke, which are often complicated, and to apply such remedies as are practical, which must often be indirect, as the direct remedies would very generally be, to pull down a great part of the house, and rebuild it on proper principles. It has, however, only been by a knowledge and judicious application of those principles of *prevention*, that the author has ever succeeded in effecting a *cure*.

As connected with this subject, he has inserted in the Appendix several remarks on cleaning chimneys, and preventing fires, which he hopes will not be unacceptable or judged out of place: some of these he has extracted from a pamphlet of great merit, lately published, entitled "Hints for Preventing Damage by Fire, by Alfred Beaumont, Architect." He has also inserted extracts on chimneys and smoke, from Count Rumford, Dr Franklin, Mr Tredgold, &c.; and hopes that the whole will be found a sufficient guide to the architect and smoke-curer, as far at least as the ventilation of chimneys is concerned.

A PRACTICAL TREATISE, &c.

CHAP. I.—INTRODUCTION.

THE CONSTANT TENDENCY OF THE ATMOSPHERE TO RESTORE ITS EQUILIBRIUM, WHEN THAT HAS BEEN PARTIALLY DESTROYED OR INTERRUPTED BY ANY PART OF THE ATMOSPHERE BEING HEATED—THE CAUSE OF THE ASCENT OF SMOKE.

THE earth is everywhere surrounded, to a very considerable height, with a great body of air called the atmosphere. This air is a thin elastic fluid, subjected to the same laws with other elastic fluids, and consequently it has a constant tendency to preserve an exact equilibrium in all its parts, and to recover it when lost or interrupted; so that if, at any time, the weight of it is diminished at any place, the heavier air rushes from all surrounding parts towards that point, till the equilibrium is again restored.

The air, from its elasticity, is susceptible of a degree of compression beyond what we know, and of a proportionate expansion, which is so great, that if the weight of the incumbent atmosphere was taken off from any given part of it, that part would immediately diffuse or

expand itself, so as to occupy a space almost infinite in comparison with what it occupied before ; therefore, on account of this quality of elasticity, that part which lies nearest the surface of the earth being the most compressed, must be the densest and consequently the heaviest. The higher the air is, therefore, the less must be its density and specific gravity, because there is less incumbent weight above it, and from its elasticity the greater will be the space occupied by a given quantity, which, in the upper part of the atmosphere, will be almost unbounded.

From this elastic quality of the air it will be evident, that where half the pressure is removed, the expansion and space occupied by it will be double ; which proportion of the expansion to the decrease of pressure holds good, with but little variation, from the surface of the earth upwards. When any portion of air is exposed to heat, it becomes immediately expanded to a great degree, so that the same quantity of it occupies a much larger space than formerly : hence it necessarily follows, that when a fire is kindled in any place, the air immediately contiguous to it will be heated, and so, rarefied and rendered lighter, bulk for bulk, than it was before. This may be illustrated by a familiar experiment :—If a small quantity of air be tied up close in a soft bladder, and that be exposed to the heat of the fire, it immediately swells up, fills, and distends the bladder ; and if more heat be applied, the bladder will at length burst with a great explosion. It follows, as a natural consequence of this expansion of heated air, and proportionate diminution of its weight according to its bulk, philosophically termed its specific gravity, that the cold, dense,

and heavy air surrounding it will rush rapidly into the comparatively vacant space occupied by the heated air.

But as it is an invariable rule among all fluids, that those which are lightest rise upwards, and at length swim upon the top of such as are more weighty, as oil above water, &c., so it invariably happens, that when any particles of the same fluid are accidentally rendered lighter than other parts of that fluid, they rise to the top, and give place to the denser and weightier parts of it. It is owing to this cause that the water at the top of a boiler is always as warm or warmer than what is below, before it begins to boil, for the particles of water that touch the bottom are no sooner acted upon by the heat below, than they become warmer and more expanded than those immediately above them, and therefore rise directly upwards and give place to denser cold particles, which, when heated, are forced in their turn to ascend in like manner towards the top.

In the same manner, it happens that when the air contiguous to a fire is heated by its action, it is immediately expanded very much, and therefore instantly rises directly upwards till it reaches the higher regions of the atmosphere, or is cooled by gradually mixing with the denser air which it meets in its ascent; and as its place contiguous to the fire is immediately occupied by the cold dense air around it, which rushes from every side towards that point, it also is heated and rendered lighter in its turn, and ascends in the same manner, carrying the smoke that proceeds from the burning body along with it.

It is in this manner that the constant suction of air towards every fire is produced, and from this cause pro-

ceeds the continual tendency of smoke to ascend from the surface of the earth, unless where some circumstance interrupts the course of nature.

It has already been observed, that the air nearest to the surface of the earth is densest and weightiest, arising from the pressure of the air above it; that part of the air, therefore, that lies immediately on the floor of a room, will be the first to rush in and supply the place of the heated air around the fire. This may be exemplified by the following experiments:—Let two apertures, communicating with the external atmosphere, be made in a room, the one close up to the ceiling and the other low down near the floor, each being large enough to admit a sufficiency of atmosphere to supply the discharge of the chimney. Now the door being shut, and every opening being closely stopped, excepting the chimney-vent and the two apertures above-mentioned; if, in cold weather, the room is warmed by a fire, the atmosphere will be found to rush in with great force through the lower aperture near the floor, while little or none will come in at the upper; and if these apertures be each larger than is sufficient to supply the discharge of the chimney-vent, a slow current will be found moving out through the upper one. Again, let the chimney-vent be shut up, and the room warmed by a stove, the cold air will rush in at the lower aperture as before, and will force the warm air in the room, from its being lighter, to rush out with equal velocity through the upper one; and the warmer the room is made, the more quickly will the circulation be carried on: it will also be accelerated, if the difference in height between the two apertures be increased, on account of the different pressure

of the outward atmosphere upon each. This experiment may be also tried, and, in frosty weather, when the room is very warm, will be found in some measure to succeed, by applying a lighted candle to the upper and lower parts of the opening of a room door, when about two or three inches opened.

It is from the same causes, and much in the same manner, that the more extensive motions or circulations of the atmosphere are carried on ; for heat and cold, existing in different places, and affecting different portions of the air, are the cause of winds. Thus, as the atmosphere directly under the sun receives in the lower regions a greater quantity of heat than that at a distance ; it will, accordingly, be more expanded, and, by occupying a greater space, will elevate the column to a greater height. This greater rarefaction, or expansion, in the lower regions, will induce the neighbouring cooler and heavier atmosphere to move towards this rarer and lighter, in order to restore the equilibrium ; and, by obliging the lighter to give place to the heavier, will continue to elevate the column still higher, which, as it rises above the general level, will sink, by its gravity, into the vacancy occasioned by the sinking of the heavier atmosphere below, and thus a circulation will be maintained of the colder air in the lower region flowing towards the warmer, and the contrary in the higher, imitating, on the largest scale, the circulation exemplified by the above-mentioned experiments.

It only remains on this part of the subject to remark, that smoke does not ascend, by reason of its own lightness, spontaneously ; but, being in itself heavier than

air, is impelled upwards by heated air, with which it is always blended, fire being necessary to its production.

It has been necessary to be a little diffuse on the subject of the atmosphere, in order to arrive at this last conclusion, as well as to establish and explain the two following points, on a knowledge of which the adopting of proper remedies for smoky chimneys will materially depend—first, that a constant and proportionate supply of cold air is necessary to supply the place of the heated air continually passing up the vent; and, second, that it is from the lower parts of the apartment the supply will chiefly be derived.

A knowledge of the laws which regulate the action of the atmosphere is also necessary to account for and understand those counter currents of air that often oppose and retard that current which forms the draught of the chimney or vent, and on which depends the ascent of smoke, as will hereafter be explained. Indeed all the proportions to be observed in constructing vents, and fire-places to correspond with them; and the proportion which both should bear to the size of the room to which they belong, are deduced from a knowledge of these laws. As, for instance, rooms that were intolerably smoky have often been cured by openings being made close to the floor, while openings, such as ventilators, at the top of a room in one of the upper panes of a window, or drawing down the upper sash of the window, only augmented the evil.

In the course of the following remarks, therefore, it will frequently be necessary to refer to these introductory observations on the atmosphere.

The word chimney is thus defined in the Encyclopaedia Britannica.

“*Chimney.* In Architecture. A part of a house or lodging wherein the fire is made.

“The word chimney comes from the French word *cheminée*, and that from the Latin *caminata*, a chamber wherein is a chimney. *Caminata* again comes from *caminus*; and that from a Greek word derived from *καίω*, I burn.

“The parts of a chimney are the jambs or sides, the back or hood; the mantel-tree, resting on the jambs; the tube or funnel which conveys away the smoke; the chimney-piece or moulding on the forepart of the jambs over the mantel-tree; and the hearth or fire-place.

“Professor Beckman having proved to our entire satisfaction, that chimneys such as we have now in every comfortable room, were unknown to the most polished nations of antiquity; sets himself to inquire into the era of their invention, and the oldest account of them, which he finds, is an inscription at Venice, which relates, that in the year 1347, a great many chimneys were thrown down by an earthquake. It would appear, however, that, in some places, they had been in use for a considerable time before that period, for De Gateris, in his history of Padua, relates that Francesco de Cararo, lord of Padua, came to Rome in 1368, and, finding no chimneys in the inn where he lodged, because, at that time, fires were lighted in the middle of the floor of the hall, he caused two chimneys like those which had long been used at Padua, to be constructed by masons and carpenters, whom he had brought along him. Over these chimneys, the first ever seen in

Rome, he affixed his arms, which were still remaining in the time of De Gateris, who died of the plague in 1405."

With all deference to the writer of this article, the above learned and somewhat far-fetched derivation of the word seems to be not quite correct: it is more probable that both the French word *cheminée* and the English word *chimney*, which, by the bye, may rather be considered the same word than one derived from it, are immediately derived from the French *chemin* (as *matinée* from *matin*, &c.); and as *chemin* signifies a road, way, or course, so the more appropriate acceptation of the word chimney, in England at least, applies rather to the vent or course of the smoke, though it also signifies all the other parts collectively enumerated above.

It appears, however, from the above extract, that the Latin *caminus* did not signify a chimney with a vent, &c., such as we have them now, but a hearth, or fireplace merely, somewhere near the middle of the floor.

It could not be long before men must have discovered that, when fire was surrounded with a wall to any considerable height, the motion of the wind was intercepted by it, and the smoke allowed to rise upwards till it reached the top of the building. The free ascent of this disagreeable vapour, it would likewise soon be found, was promoted by the addition of a roof, which being more useful on other accounts would soon be adopted. So it happens that, in every part of the globe, the first and simplest huts of savages are circular buildings, with a conical roof, in which, for the most part, is left a hole for the emission of smoke; the fire being placed in the centre of the building, immediately

below the opening, which serves instead of a window as well as a vent-hole for the smoke.

Such a form of huts was sufficient to accommodate mankind in the earliest stages of civil society ; but as the useful arts were introduced and increased, and the human powers were gradually developed, it was found that their habitations might be rendered more commodious by adding some building beside the fire-place and opening into it.

The fire apartment being no longer the whole of the house, there was no necessity for having it so large as formerly, and so it became gradually contracted to a less considerable size ; yet for a long time such chimneys or fire apartments continued rather a separate building, included within the house, and could be constructed separately after the house was finished, as appears by the above relation of Francesco de Cararo. If the door or opening into this separate fire apartment was large, the influence of its fire would pervade the whole of the apartment or house surrounding it, while at the same time the outer apartment would be free from annoyance by the smoke. Chimneys of this sort are still common in farm houses, in some parts of Scotland.

But as luxury increased, and the elegant arts became more common, these fire-places were constructed of a still narrower size. The grate, instead of being placed in the middle of a large area, with seats around it, was pushed close to the end wall, the wideness of the opening of the vent was found to be sufficient, if it contained the whole of the grate ; and, as the fire warmed the room more effectually, when it came well forward, the grate was brought as far forward into the apartment as

could be done. The pipe or vent of the chimney was contracted to such dimensions as to admit of being contained within the thickness of an ordinary wall, and reduced to that elegant and commodious tube, now and for a long time, known by the name of a chimney-vent.

Chimney-vents were at first very rough and uneven in the surface of the building inside ; they afterwards were roughly plastered ; and more lately they have been rendered more perfect by the now almost universal mode of building them round a movable frame or mould, called a cylinder, which draws up as the building of the wall containing the vents advances.

As this form of chimney is the most elegant, commodious, and efficacious for carrying off the smoke from our apartments, the object of the present essay is to point out the most advantageous manner of constructing it, in relation to the house, situation, and arrangement of its apartments, &c., as well as to point out the defects, and means of detecting them, in chimneys already built, and which are found not to vent well, and to show the remedies most appropriate for such defects.

As the primitive human habitations in all countries, as described above, may be said to have been all chimney, this wide vent, in which the smoke was first enclosed, has been gradually contracted, not from any knowledge of, or attention to, the natural principles upon which smoke ascends, but from a regard to convenience and elegance, which being the sole rule for constructing vents, it was not till the necessity of making several of them carried up within the same wall, caused them to be bent and zigzagged to avoid one another, and thus opposed a resistance in many cases sufficient to over-

come the natural tendency of smoke to ascend, that the evil of smoky chimneys began to be felt, and appropriate remedies for them inquired after.

There are, indeed, some savage nations, the Laplanders and others, who seem indifferent to the annoyance arising from living in smoke, as appears from their having no other openings in their habitations for emitting the smoke but the doors and windows.

But as mankind advance in civilization ; as they become easy in their circumstances, and come to form a more adequate notion of enjoyment, and acquire an idea of cleanliness and the comforts arising from it, smoke in their houses becomes so exceedingly disgusting as to be accounted one of the greatest domestic nuisances, and is, therefore, excluded from their apartments with every possible care.

But if it is necessary in other parts of the world to exclude smoke merely for the sake of gratification, it becomes doubly so in Great Britain, where pit-coal is the most common sort of fuel, the smoke of which is not only disagreeable but highly noxious, as many well known facts too fatally prove.

To guard against this nuisance much ingenuity has been exerted, and many contrivances have been adopted, but unfortunately these have been for the most part the inventions of men, who, being unacquainted with the physical causes of the ascent of smoke, explained in the preceding part of this chapter, were not qualified to distinguish, with certainty, those circumstances that are most essentially necessary for promoting the emission of smoke, or such as tend most powerfully to obstruct its going off freely : hence their efforts have been

chiefly directed to improper objects ;—and the inhabitants of this country feel to their cost, that in an age when philosophy has lent its aid towards perfecting almost every other art, the builder of chimneys has been left to grope his way in the dark without an assistant, and, in almost every instance, his attempts to improve upon the practice of his predecessors have been unsuccessful.

The chief design of the present essay is to explain, in a concise and perspicuous manner, the circumstances which can promote or retard the ascent of smoke in chimneys, and to point out the means of curing, in the most effectual manner, all chimneys that do not vent well, where they can possibly admit of a cure ; as well as to instruct the operative mason how to construct new vents in such a way as to carry off the smoke effectually in all cases and situations whatever.

As the ascent of smoke has been shown to be a law of nature, we may rest assured, that, unless some considerable opposition be offered to its progress upwards, it *must* rise ; that opposition may consist of direct obstacles, or some counteracting power arising from a great many circumstances that may tend to produce other and opposite currents of air to that already noticed, by which the discharge of the smoke is effected.

Although there are very many of these causes and circumstances, and though an inexperienced person, on examining the defects of a smoky chimney, would be much puzzled to find them out ; yet an experienced smoke-curer will be enabled with certainty to detect them, and as far as practicable to apply the proper remedies ; neither is this surprising, since wherever the

smoke does not freely ascend, these defects must, more or less, certainly exist.

Whatever can retard or facilitate the ascent of smoke in chimneys must exist either,

First, In the chimney itself ; or,

Second, In the position and proportions of the interior parts of the house, and of the doors and windows with regard to the chimney ; or,

Third, In the exterior position of the house with respect to surrounding objects.

Under these three general heads may be classed all the defects of proportion, arrangement, and situation, which, with their preventives and remedies, are to be considered in the following chapters.

CHAPTER II.

THE SIZE, SHAPE, SMOOTHNESS, AND EASY COURSE OF THE CHIMNEY VENT; THE POSITION OF THE FIRE WITH RESPECT TO IT; THE SIZE OF THE FIRE-PLACE WITH RESPECT TO THE VENT; AND THE PROPORTIONS AND POSITION OF BOTH TO THE SIZE AND VENTILATION OF THE ROOM OF THE UTMOST IMPORTANCE TO THE ASCENT OF THE SMOKE.

THE construction of the chimney, vent, or tube intended to convey away the smoke from our fires, that so we may enjoy a comfortable warmth without annoyance, might at first sight appear sufficiently perfect if it offered no very evident obstruction to a law of nature apparently powerful enough to overcome trifling obstacles; but on a nearer view of the subject, and bearing in mind the effects of heat on the air as explained in the introduction, it will appear that many apparently trifling modifications in the size, shape, and direction of this tube will have far more powerful effects on the ascent of smoke than would at first be imagined.

On this part of the subject the best course would appear to be, to consider in their order the various dimensions of the vent combined with the circumstances of shape, &c., best calculated to promote the end in view. These we will consider under twelve heads.

1st. The length of the vent is a very material circumstance, for the longer or higher it is, the greater will be the difference between the weight of the column of heated air within the tube, and that of an equally sized column of atmospheric air surrounding it; and consequently the air will enter with the greater force at the bottom of it, and carry up the smoke with the greater rapidity along with it; for, as the warm air within the tube continues rarefied in a high degree, till it issues from the top of the chimney; and as it is in every part of its length lighter than the same bulk of external air, it follows that the longer these two columns of unequal gravity are, the greater must be their difference of weight, and of consequence the pressure of the most weighty into the only opening of the lightest will be the greater. Hence it is that high chimneys, *cacteris paribus*, have a greater suction of air, and are less liable to vent ill, than low ones; and this is one principal reason why, in the same house, the chimneys in the garrets and higher stories vent worse than those on the floor, whose chimneys are of necessity longer. A smoky chimney may therefore sometimes be cured merely by raising it higher than formerly. It follows from the same principle, that if an opening be made into the vent, in any part of its course, the air will enter with less force at the opening at the fire-place, and carry up the smoke with less velocity than before, and thus be in danger of occasioning smoke in the apartment from whence it leads; for this opening, as it admits the fresh air into the tube, will have nearly the same effect as shortening it so much would have had; so that any openings into a vent, either from the external air, or from

any other vent not in use, will be likely to occasion smoke, as being equivalent in some degree to shortening the vent.

Hence we may likewise see the reason why a chimney ought in general to vent better, and make the fire burn more briskly, in very cold weather, or in extremely cold climates, than in such as are warmer; for as the air that passes over the fire into the vent will, in both cases, be heated nearly to an equal degree, the column of air within the vent will be nearly of equal weight in both; but as the density of the external air is greater in cold than in warm weather, the difference between the weight of the two columns upon the whole will be in cold weather more considerable, and consequently the suction more violent, which will continue to be accelerated in proportion to the height of the vent.

Should it be objected to this reasoning, that the barometer shows that the weight of the atmosphere is, upon the whole, as great in summer as in winter, and that therefore the reasoning cannot be just, I answer, it is very true that the weight of the whole body of the atmosphere, and consequently of a column of a given diameter reaching to its top, may be of equal weight at these two seasons; but as the air in cold weather is so very much condensed, the same weight cannot reach nearly to the same height in winter as in summer; so that the weight of two given columns of equal altitude must at these seasons be very dissimilar.

2nd. The wideness of the vent is of very great importance, for, as every fire requires a constant supply of fresh air, the tube for conveying this rarefied air to the higher regions of the atmosphere, must be of a size

sufficient to contain the whole of it, and allow it a ready passage ; otherwise a part of it will be forced to seek some other passage, and will thus naturally diffuse itself into the apartment in which the fire is placed. Every chimney, therefore, ought to have a degree of wideness sufficient to carry off the whole of the smoke arising from the fire usually burnt in it, otherwise the apartment will be almost continually filled with smoke. This is a common fault, especially in large towns, where the number of chimneys in one wall is often so great that it is difficult to get a sufficient space for each.

It was formerly the general practice to make the aperture of every vent a square or oblong, or an irregular, four-sided figure of some sort ; which, on every account, was an improper form, and has been gradually relinquished, chiefly from its being inconvenient for cleaning, by a bundle of twigs drawn up and down, the most eligible method of cleaning chimneys. As the twigs could not be pressed into the corners, the soot remained in them in spite of the utmost efforts to clear it out, which was not only disagreeable on account of its falling frequently into the apartment, but dangerous also for catching fire. It is to these and other considerations of convenience, rather than to any more philosophical reasons for preferring it, that we owe the adoption of the cylindrical vent, now almost universally in use. The thinness of the walls has fixed the shape of it to the flat oval ; and this, together with the necessity of smoothness and equality of interior surface for the sake of rendering the chimney the more susceptible of cleaning, has introduced the use of a flat oval cylinder, formerly mentioned, which is drawn up within the vent

as the building proceeds, and serves as a mould round which the vent is constructed of an exact equality of shape throughout its extent. To this cylinder, however, other considerations will suggest a farther and very desirable improvement. Before concluding the present article, as referring more particularly to the wideness of the vent, it will be the fittest place to remark that though very large apartments will require a proportionally wider vent, yet the shortest diameter of the above described flat oval should never be less than nine inches, nor its longest more than twelve.

3rd. The vent should, from the bottom, assume these dimensions just mentioned, and the shape of the cylinder as close to the fire as possible, that is, as the proportions of the fire-place to the room, hereafter to be described, will admit of. The neck of the vent should begin then as low down as the mantel tree, immediately over the fire; for, as the smoke is forced up the chimney merely by the rarefaction of the air in consequence of heat, it is evident that the more the air is heated, with the greater force will it ascend, because the difference between the weight of the external and internal air will be greater: and as the air will be the more heated the nearer it is made to pass over the fire in its entrance into the vent, it is evident that the sooner the wideness of the fire-place is contracted into the tubular form of the vent, and the lower down or the closer to the fire that contraction takes place, the air in entering it will be made to pass the nearer to the fire, and so being more heated and rarefied will ascend and carry the smoke along with it with the greater velocity.

4th. The vent ought to be several inches wider at

the top than at the bottom, that is, gradually widened from the neck upwards, by a uniform taper throughout its course.

The air, as it enters the neck of the vent immediately over the fire, must be very hot and rare, and, consequently, if not obstructed, will rush upward with great force. But, though the vent prevents it from being laterally cooled, yet mere distance from the fire will cause a proportionate reduction of its temperature as it ascends. As that reduction will always be increasing, the velocity of the stream of air in its progress upwards will decrease in the same proportion, and, consequently, a sort of accumulation and thickening of the smoke will take place in the upper end of the vent; at least where it does not widen gradually, there will be such a tendency, though the effect of it may be prevented by the vent, &c., being in every other respect properly constructed. But if such a chimney be disadvantageously situated, where the wind bears down into it from causes hereafter to be noticed, it will give way to the wind, and the smoke will be forced down into the room, which would not take place were the vent constructed on the principle of gradual expansion.

By this principle the tendency of the smoke to accumulate will be relieved by the column finding more room as it advances, in proportion as it falls off in velocity.

Though this system of building vents is scarcely practised, and indeed the improvement is hardly known, yet it may be depended upon, and in the author's experience has cured smoke where every other remedy had failed, in most unfavourable situations: he would

therefore strongly recommend to those about to build houses ; and the practical mason ought to have the vents constructed with less or more of a gradual increase of diameter as they rise.

In order to accomplish this, the improvement on the common cylinder above hinted at will become necessary. Instead, therefore, of the cylinder consisting of one piece drawn up as the building proceeds, let a number of pieces be made, each of a gradually increasing diameter, the narrowest to be used first, next to the fire-place, and each succeeding one having its narrower and lower end to suit the upper and wider end of the one immediately preceding it; and let them be numbered in succession. Any degree of taper could thus be given them to suit the proportions of the vent; for, where it is very high, a great deal of taper could not be admitted without widening the vent more at the top than the room in the wall and chimney stalk would allow, especially in houses where the vents of many apartments have to be carried up in the same wall.

5th. The internal surface of the vent ought to be as smooth as possible.

In order that this smoothness may be attained and preserved, it will be necessary to use the very best prepared and tempered plaster for the inside of the vent around the cylinder, and to work it hard and perfectly smooth with a suitably rounded trowel.

In order that all this may be accomplished, it will be necessary to have each successive piece of cylinder to go down a little into the place that was occupied by the preceding one ; and so each must have its lower end a little narrower than the wider end of the number just

preceding it. Hence, if the pieces of cylinder are of a convenient shortness, the whole course of the vent will be easily accessible to the hand and trowel.

When the first piece of cylinder has been drawn out of the vent, and the space it occupied well smoothed with the trowel, the second or succeeding number can be introduced an inch or two into the upper part of the space occupied by the first, without deranging or ruffling the smoothness of the plaster, or if any such ruffling does take place, it may be easily reached by the trowel when No. 2 is withdrawn. The pieces, therefore, ought not to exceed a length convenient for this purpose.

This smoothness of the vent is chiefly desirable for rendering it capable of being easily and perfectly cleaned, and the hardness and compactness of the plaster for preventing it from being injured by the apparatus used in cleaning; both the hardness and smoothness will likewise have some effect in preventing the accumulation of soot.

6th. When, in order to avoid other fire-places and vents in the same wall, the vent must be bent to a side; that must be done by an easy and gradual curve, so as entirely to avoid any thing approaching to an angle or acute curve.

Angles or a zigzag course in vents, are found to be extremely prejudicial to their venting well: but a gradual and easy bend is so far from being so, that it has been recommended; because if a vent be perpendicular, and of a proper wideness to transmit the whole of the smoke and no more, it will not be sufficient for that purpose when there is a heavy fall of rain, snow, or hail, with little wind; for the great drops that enter at the

top will fall perpendicularly from the top to the bottom of the vent, and as they occupy a considerable space, the smoke will not have room to ascend, and by the effect they have in cooling the air within the vent, together with the impetus of their contrary direction, it will be forced down with the shower and dispersed in the apartment ; whereas if the chimney is bent, the rain falls on one of the sides, and glides gently down without disturbing the ascent of the smoke.

The same inconvenience will be found in a straight vent, where it is so placed as to be exposed to winds, which sometimes enter the top, and blow down with sudden swells : for if it be straight, the air meets with no interruption till it descends into the room, and scatters the smoke before it ; but if it be curved, the descent of these gusts of wind will be broken, and partially obstructed, and their bad effects in a great measure prevented.

7th. The position of the fire ought to be immediately under the throat or lower opening of the vent, and as near it as the proportions, after mentioned, will allow ; at the same time as far forward into the apartment as to bring the breast bars of the grate right below the inner edge of the mantel, the outer frame stone of which ought therefore to have its lower edge as thin as possible, and to grow gradually thicker upwards, as its inner lip at the under part must determine the place of the front bars of the grate to be right below it.

This forward or projecting position of the fire, by throwing it more in the way of the current of air, passing from the room to the vent, will cause the air to be more heated, the advantages of which have been noticed under

the third article of this chapter. It will also increase the effect of the fire in heating the room.

8th. The fire itself ought to be as broad in front as convenient, as the more of the space between the chimney jambs that the fire occupies, the more will all the air entering the vent be exposed to its heat.

This remark is so nearly allied to the preceding one, that it has only been stated separately in order that, being a circumstance of importance, it might not escape attention.

9th. The inside part of the fire-place, extending laterally from jamb to jamb, and upward from the grate to the mantel, ought to be a flat semicircle, contracted by being bent inwards from all points immediately on reaching the height of the lower edge of the mantel, only so as to avoid acute corners ; so that the insertion of the vent into it at the throat may resemble the insertion of the tube of a funnel into its mouth, or that of a stove-pipe into its fire-place.

By this form, all the air that can enter the throat of the vent will be forced to pass either directly over or very near the fire, the importance of which has been already sufficiently explained.

10th. The height of the fire-place, from the hearth to the mantel, ought never to exceed one third of the height from the hearth to the ceiling.

This proportion may, to some, appear inelegant ; but it is sufficient here to point out evident advantages, leaving their adoption, of course, to choice. The great importance, however, of having the lower end of the vent as near to the fire as possible, has been sufficiently noticed, and it is to be hoped that in this particular, taste

will ultimately yield to utility. The wideness of the fireplace is not perhaps of so much importance ; it may be left to taste to form it of a suitable proportion to the height.

11th. In placing of smoke jacks in kitchen chimneys, they must be regarded as in some degree an obstruction to the free ascent of the smoke. It is therefore necessary to allow the smoke to form a regular current before meeting with such resistance, so that jacks ought always to be placed as high as the ceiling will allow, and certainly never less than nine feet from the floor.

12th. Although the author does not positively lay it down as a principle of constructing vents, yet he has to state that he has often had occasion to remark the superior draught of vents constructed with their longest dimension across the thickness of the wall ; that is to say, with the edge of the tube to the surface of the wall, and where the thickness of the wall will admit of it, bent a little backward from the fire. In which case, if the vent is brought very near to the outer surface of a gable wall, the smoke will be prevented from penetrating to, and blackening the surface, by the inside of the vent being plastered with a composition consisting of two fifth parts of plaster lime, two of sand, and one of fresh cow dung, well mixed.

CHAPTER III.

THE SITUATION OF ENTRY DOORS AND WINDOWS, AND THE ARRANGEMENT OF THE INTERNAL DIVISIONS OF A HOUSE OUGHT TO BE SUCH AS TO GIVE RISE TO NO CURRENTS OF AIR THAT MAY CROSS OR OPPOSE THE CURRENTS TOWARDS THE VARIOUS FIRE-PLACES, WHICH MUST, NEVERTHELESS, BE SUPPORTED BY SUFFICIENT VENTILATION.

WHILE the currents of air, passing continually over every fire in a house up the several vents, must be supported by a more or less direct communication with the external air, it should be admitted in such a way as to forward and not oppose or retard these currents : therefore, although air must be continually drawn into a house, there should be no considerable current of air passing out of a house excepting by the vents.

If, for example, there be a long straight passage, leading from the entry-door of a house on the one side, to a back-door opposite to it on the other side, a rapid stream of air will rush from the windward to the other side of the house, even when the doors are shut ; and the air in such adjoining apartments as open into this passage will be forcibly drawn out of them, and even down their vents, whenever the current in the passage

assumes a sudden increase of velocity from the opening of the doors.

It requires no great consideration to discover that all long passages, nearly straight, running through houses, and communicating at both ends with the external air, will form strong currents along their course in the direction of the wind, which will, more or less, induce a draught of air from the adjacent rooms, and, instead of supplying the currents of their vents, will form an opposition to them by drawing down the heated air and smoke.

Though this be extremely plain, yet there are many more complicated and less observable circumstances that occasion temporary and partial currents; and others that occasion sudden swells and whirls of air, the former accompanied by general dulness of draft in the vents, approaching to stagnation, and the latter by bursts and eddies of smoke issuing by turns from the chimney.

That constructions having such a tendency may be avoided, the following particulars are submitted to the consideration of the architect.

1. Rooms ought to be sufficiently ventilated to supply the waste of air by the chimney.

If, therefore, in new houses, the doors and windows are so closely fitted as not to admit a sufficient supply of fresh air, and if the chimneys smoke in consequence, which may easily be known by their being cleared by the opening of a door or window, some plan for admitting the air must be adopted, several of which will be pointed out under the head of remedies.

2. A house should have an equal number of openings, as doors and windows, on each side.

A house without openings on the one side would, when the wind blows on that side, have a suction of air going out from all the openings on the lee side, which would tend to supply itself by drawing air down the vents, and so obstruct and oppose the ascent of the smoke.

Again, if in a house with an equal number of openings on both sides, these openings be nearly opposite; or if there be a direct communication from the openings on one side to those on the other, the suction from those on the lee side will be increased. Therefore,

3. There should be no direct communication, or free passage, between the opposite openings; the best way to obviate which is to build the house of such a wideness as to admit of two rooms abreast, or what is called a double house; and, in this case, to avoid having doors opening from the one room directly into the other, which will, in many cases, occasion smoke where it would not otherwise have been.

If circumstances do not render it eligible to build this sort of double house, the same end will be attained by avoiding windows in the opposite sides of the same apartment, and making the windows of some of the rooms wholly on one side of the house, and those of the other rooms wholly on the other side. This will preserve the necessary balance, and prevent the violent draught of air between them, as each room will be ventilated on one side, and there being no outward current from it but by the vent, it will consequently discharge its supply by that channel only.

4. Long passages are as much as possible to be avoided; but if they are admitted, they should either

be closed at one end, or both openings should be from one side of the house. Should the entries into a passage, however long it may be, if it is uninterrupted, be from opposite sides, or the one from a side and the other from an end, a current will run along that passage almost as violent as in the case supposed at the beginning of this chapter; but if both openings are in one direction, the wind will blow into them both at once, and thus a current will be prevented.

Long passages should never terminate in an open apartment, having a fire-place, or in a staircase, or in any place that has a free communication with the higher parts of the house.

For this reason it is always better to contrive matters so as to have kitchen, cellars, &c., under the same roof with the dwelling-house, than in other detached buildings, by way of wings to it; a practice very prevalent in country houses, although it is attended with many inconveniences besides the one now under consideration.

5. Wings, therefore, if built for ornament, should consist of such buildings as have no necessary connexion with the house, nor any internal communication with it. If circumstances make it necessary to have the kitchen, &c., as wings, let them communicate with the house, if possible, only by the principal entry: and if two buildings project from the body of a house, by way of wings, with an open passage communicating from the one to the other, terminating in a door at each end, in that case both the doors ought to open into the inner side of the court, fronting each other. It is only necessary further to remark, with regard to such projecting buildings, that if the house is placed upon a

considerable declivity, they should be thrown towards that side which is higher than the house.

6. There should only be one principal entry-door to a house, which ought to open directly into a close landing place that has no immediate communication with the staircase or common passages through the house, unless those passages are quite close at each end; this may easily be practised in houses of a moderate size. In larger buildings, where it is necessary to have a separate entry for servants, this entry ought, in general, to be on the same side of the house with the principal entry in an under floor. Although the principal entry to the house is usually determined by the situation of the ground on which it is placed, yet, if all other circumstances are equal, smoke would be most effectually prevented if it were made to front that quarter from which the wind blows most violently for the greatest part of the year. But, if the situation does not admit of this, care ought to be taken to place rather a greater number of windows upon the windy side than the reverse, which will counterbalance the inconveniences that may arise from the door being wrong placed. The door, in this case, ought to be made to shut extremely close. If a house is built upon the side of a hill, or on any long declivity, for the sake of symmetry, and in compliance with established custom, the front must be towards the foot of the hill, although this, of all the positions that could be chosen, is most liable to produce smoke. Sometimes the entry for state may be made in that front, and another entry for common use made in some other part of the building, which may, in some measure, obviate the inconvenience, especially if there

is no direct communication between the two entries, and if the principal door for state be made to shut extremely close. But if there be a direct communication between the two doors, the whole house might be filled with smoke in a few minutes, when the principal door was opened while the wind was blowing down hill. To obviate this inconvenience, in all situations where the entry of a house, situated upon a long declivity, is on that side which looks towards the valley below, great care ought to be taken, not only to have the principal door to shut as close as possible, but to have it further secured by a close portico without, if it does not open into a perfectly close lobby or landing-place within the house. All the doors that have any communication with this, ought to be so constructed as to close with the most perfect exactness, and to shut of themselves, to prevent the disagreeable consequences of accidental carelessness.

7. The staircase ought to have no direct communication with the entry door ; this communication ought only to be through passages, with doors upon them, always shut, unless when occasionally opened. The staircase from the servants' flat to the principal floor ought to terminate in a close landing-place, communicating with the principal apartments, passages, and staircase, through doors opening into each.

The staircase ought to be made as close as possible upon all sides, especially towards the top, where it ought, on no account, to have a free communication with the garrets, or with the ceiling of the house ; for these are usually so open and airy as would occasion a constant draught of air between them and the lower apartments, were the communication at all direct. The stair leading

to the garrets and ceiling should, therefore, be from some part of the highest floor that does not immediately communicate with the principal staircase.

8. Small rooms ought as much as possible to be avoided; for these are always much more liable to be troubled with smoke than such as are of a larger size.

All room doors open inwards, so that when the door is opened it presses upon the air within the room in some measure like the leaves of a bellows, and pushes it backwards, so as to force it into any passages it may meet with leading from the room. But when it is again closed, it makes a temporary kind of vacuum in the room, so that the air rushes back again into the room through those passages that communicate with it from without. Of the truth of this observation any one, who has an opportunity of seeing a room that has two doors opening into it, may easily satisfy himself experimentally; for if one of the doors be left loose, and the other be opened pretty quickly, the door that is loose will be pushed forward by the pressure of the air so as to close; but when the other door is closed, it will be again pushed back, and remain open. This experiment may be repeated as often as you please without ever failing.

In consequence of these contrary motions of the air in a room, produced by the opening or shutting of a door, it invariably happens, that when the room door is opened, a greater quantity of air is forced into the chimney than usual; and when the door is again closed, the air is drawn backwards from the chimney into the room in a greater or less proportion, according to particular circumstances, which has always a natural tendency to produce a burst of smoke from the vent into the room.

These effects must take place in some degree in all sorts of apartments ; but it is sufficiently obvious, that they will be more or less sensibly felt in proportion to the size of the room : for, in a small room, the quantity of air displaced by the motion of the door, bears so great a proportion to the whole air in the room, as must occasion a very sensible pressure upon it, and force a great proportion of the air up the chimney with considerable violence, when the door is suddenly opened, the want of which must be again supplied from the chimney by a similar violent draught of the air downwards, when the door is shut, which almost infallibly brings a considerable quantity of smoke along with it.

But when the room is large, the quantity of air displaced by the door, as it is opened or shut, bears such a small proportion to the whole, and is usually at such a distance from the chimney, as to produce no sensible effect.

It is almost superfluous to observe, that the same effects will be produced by opening or closing a press door within the room, as by opening or shutting the room door, in a still higher degree in proportion to the size of the press door.

It is likewise sufficiently obvious, that when any person moves through a room, the air must be displaced by the body of that person, so as to produce an effect of the same kind, in proportion to the size of that body ; for when one moves towards the fire-place, a quantity of air is pushed before his body towards it, and forced up the chimney ; but when he retires from it, a proportionate quantity is drawn down the chimney to supply the vacuum left by the retiring body.

In a small room, the size of a human body bears such a proportion to the whole contents, and all the motions must necessarily be so near the fire-place, that it is hardly possible for a bulky person to move about in it without disturbing the draught of the chimney, and occasioning bursts of smoke ; but in a large apartment, a perfect freedom of motion is allowed to every person in it without the smallest danger of producing any of these disagreeable effects.

On these accounts, were there no other reasons for it, those who wish to live comfortably in their houses ought always to avoid small rooms.

But small rooms are attended with so many other inconveniences, that it is surprising they have been so generally tolerated.

A fire is no sooner fairly kindled in a small apartment, than its influence is strongly felt in every corner of it. The small quantity of air it contains is suddenly so heated as to become nearly insupportable.

But that fire is hardly abated in its vigour a few minutes in a cold climate, when the small quantity of warm air that was in the room is carried off through the chimney, and its place supplied by the cold air from without; so that it becomes in a short time as insupportable, for the intense degree of cold, as it was a short while before for its extraordinary heat. Thus those who inhabit such apartments are alternately exposed to the most sudden and violent extremes of heat and cold, which cannot fail to be attended with the most fatal effects to persons of a weakly constitution.

Even when the fire is burning with its greatest fervour, the door is no sooner opened than a blast of cold

air pervades almost the whole room, and chills those parts of the body that are not exposed to the immediate influence of the fire.

And although the door should not be opened, the cold air that is constantly drawn through the different crannies of the room to supply the waste made by the fire, having such a short passage between those crannies and the fire-place, is heated but in a very small degree, by mixing with the warm air of the room in its passage ; so that it acts with great force on those parts of the body that it meets with in its way, and cools them to an intolerable degree.

The same inconveniences are felt if it is employed as a bed-room. If the fire is vigorous at bed-time, it will be then too hot ; but no sooner is that diminished, than the whole room is instantly filled with air as cold as that without doors.

Such are the unavoidable consequences of employing very small rooms, all of which disagreeable effects might be entirely prevented by having larger and more airy apartments. In these it takes some time for a fire to heat the whole air of the room, no part of which can ever become so hot as in one that is smaller ; because the heat has greater freedom to expand itself, and mix with the cooler air in other parts of the room.

And as a great body of air is thus heated in a moderate degree, by the continued action of the fire while it lasts, it is long before all that heated air can be carried off, even after the fire is extinguished ; so that the vicissitudes between heat and cold are neither so sudden nor so violent as in the other case.

The opening of a door, in an apartment of this sort,

has also a much less sensible effect upon those who are in it, as the cool air that enters gradually mixes with the warm air in the room, and in its longer passage, before it reaches the company, is so much blended with it as to be hardly sensibly perceived.

Still less sensible will be the effects of the air that insinuates itself through the crannies of the room to supply the fire ; so that those who are in such an apartment, enjoy a much more temperate and equable heat at all times than those who inhabit smaller rooms, and are, in consequence, much less exposed to the disorders that arise from these causes.

And, in bed-chambers, the difference is the same ; for the moderate heat they enjoy at bed-time is only agreeable, and it will not be so much abated before morning, as to be productive of those bad effects that must be experienced in small sleeping rooms.

On all these accounts, large apartments for all purposes cannot be too much recommended ; nor can a taste for small rooms be defended on any other principle, but that species of vanity which annexes an idea of gentility to the possession of numerous separate apartments.

It is hoped that the usefulness of these remarks will excuse the digression, and to return :

9. If there are strong partitions in the inside of a house, it will be a great advantage to have as many chimneys as possible in these partitions, and that for two reasons : First, because the higher the temperature of the air in a vent is, it will draw the better ; and these partitions, being entirely within the house, are not exposed to the external cold as the outer walls are.

Second, because currents of air within a house are in

the direction of the wind ; the chimneys in that wall of a house which is immediately exposed to the wind, will have currents blowing from them, that is, in a contrary direction to their draught ; but chimneys in partitions will be less exposed to such currents, as their force is always greater in the apartment next to the wind. Therefore,—

10. It will be desirable, where they cannot be so conveniently placed in partitions, to have as many of the chimneys as possible on that side of the house which, from its situation, may be least exposed to the quarters from which the wind more generally blows, as the draught always lies in the direction of the wind ; and such chimneys as are situated as it were between the wind and the house, will, for the time, have the natural upward draught of the chimney opposed by a tendency in the wind to force a current down them.

11. Not only must there be a sufficient admission of air into a house to supply the draught of its chimneys, but every room, nay, every vent, must directly have the means of furnishing itself with air without opposing the current of another vent. Thus vents are sometimes so injudiciously placed, with regard to one another and to the supply of air, that they overpower each other, as Dr Franklin expresses it.—See his Essay on Smoke in Houses, in the Appendix.

12. In some houses, where the flats are closed in, each by itself, although it will have the effect of preventing currents, as explained above, it may, nevertheless, in some cases, occasion too great closeness of the rooms, and prevent the admission of air enough for the ventilation of the chimneys. In such cases the author has

often cured smoky chimneys, by simply placing a wheel ventilator in the fanlight over the door communicating with the staircase. As these doors generally open into passages where the air is not much heated above the temperature of the air on the staircase, there will be no more propriety in ventilating them below than above ; on the contrary, the ventilator being placed in the fanlight, will admit of the door being quite closely fitted at the foot, which will prevent dust being blown from the floor along the passage by air being admitted below the door.

CHAPTER IV.

THE SITUATION OF A HOUSE WITH REGARD TO SURROUNDING OBJECTS, SUCH AS HILLS, BANKS, PRECIPICES, OR OTHER BUILDINGS, WILL MATERIALLY AFFECT THE VENTING OF ITS CHIMNEYS.—PRECAUTIONS IN BUILDING TO BE OBSERVED ON THAT ACCOUNT.

THE third general cause of smoke in houses, is the wrong position of the house with regard to external objects, which, by interrupting the course of the air, makes it assume various directions, and wheel about in eddies, so as to prevent the smoke from ascending with ease from the chimney tops, or to beat it down into the room with violence. In this case particularly, we find chimney cans very useful ; indeed, few vents go well without them, or some substitute for them. Vents without cans are generally subject to sudden gusts of smoke during high winds ; the wind being repelled by the building, rises with violence, until it reaches the top, when it sweeps over the vent with a force that overwhelms the draught. Now, the cans being raised above the building, and there being a space between them, the violence of the wind is broken, and a part of it entering in at the bottom of the cap, or copping of the chimney head, is guided upwards by the top of the can, forc-

ing a passage for the smoke that passes over and between the cans, which would otherwise be impenetrable to the smoke itself, and is the occasion of keeping the vent warm. But still chimney tops should be put on in proportion to the size of the vent, as too narrow chimney tops are apt to choke the vent, by causing it to fill with soot. The principle on which earthen cans are made is good ; but iron cans, with flanches fixed to the stone by iron bolts and nuts, would be preferable, as it would add greatly to the safety of people walking in the streets, in windy weather. But a better construction still has recently been introduced in cottage chimney stalks ; where, instead of one stalk containing the tops of all the vents in the wall on which it stands, a separate stone top is carried up for each vent, sometimes consisting of a single stone, and sometimes built of an angular diamond shape, so that the stalk consists of a cluster of separate stone tops resembling cans, having the same effect in breaking the violence of the wind.

The wrong position of houses, with respect to surrounding or adjacent objects, is, however, less frequently the cause of smoke than either of the two general causes formerly discussed, although it seems to be almost the only one attended to at present by many who pretend to cure smoky houses. As most of their remedies are adapted to remove disorders arising from this cause alone, we shall point out the cases in which this can occur, that every one may be enabled to judge what cures are proper.

The air, as has been said, is a fluid, and wind is a current of that fluid ; which, when driven along the

surface of the earth, flows with a smooth and equal stream, unless when opposed by some object that interrupts its course. But when it meets with any object that directly opposes its course, it is in some measure pushed back again, and made to spread on every side, till it meet with some open space, into which it flows with great impetuosity. It is, likewise, a fluid of considerable gravity, and therefore presses upon the surface of the earth with great force; so that, when a current of it flows along, it has a tendency to press down while it moves forward. Whence it happens, that when a current of air is forced over the top of any high object, the side of which descends perpendicularly towards the surface of the earth, the velocity of the current at first overcomes the gravity, and it flies a short way over in that straightforward direction which it had before coming to the perpendicular side; but the power of gravity acting upon the under surface, draws it downward, and in a short space overcomes the impetus that it had to rush forward, and occasions a sort of eddy nearly similar to what we see in running water behind a stone which interrupts the violence of a current.

Suppose, therefore, a house to be placed at the foot of a perpendicular bank, precipice, or high wall, when the wind blows toward that bank, precipice, or wall, it will flow straightforward over the top of the house; but, when it meets with the bank, it will be interrupted in its course, and spread itself on every side, and recoiling in eddies, will flow towards that place through which it can most easily escape. If the opposing object be large, and if there be no opening through which it can issue near the ground, then it will ascend to the top

of the opposing object, and blowing off in that direction, will carry the smoke that ascends from the chimney of the house along with it ; but if there be any opening below, such as a street or lane, or other passage that will admit the wind to pass, then will the natural gravity of the air draw the general current downward, to flow off through the lower passage. In this case the smoke, which ought to ascend through the chimney, meeting with a current of air, opposing its passage, will not be at liberty to ascend, but will be forced back again into the room from whence it proceeded, unless some contrivance be fallen upon to prevent it.

Supposing, on the other hand, that the wind blows in a contrary direction over the same bank and house as that noticed above, (that is, when it blows from the high wall or bank,) when it comes to the brow, being hurried forward with great velocity, it goes a little forward, but soon declines downward, and is gradually inflected more and more inward, so that, pressing downwards upon the top of the chimney, the smoke is beat back again into the apartments. Thus it is that low houses, when contiguous to high objects, are in danger of being troubled with smoke.

If the contiguous object be not very high, the disorder may be cured by heightening the chimney of the low house ; but if it is very high, it will be necessary to cover the top of the chimney in such a manner as to prevent the wind from entering it, at the same time that a passage is left at some of the sides, through which the smoke may issue with freedom. Many are the contrivances that have been invented for this purpose, which are to be met with every where ; and as there is no difficulty

in accomplishing the desired end, by a great variety of methods, any one who needs such a thing may please his own fancy in the choice. A chimney top covered with openings directed downwards, is very common.

It is evident, that houses situated near high hills, or thick woods, will be in some measure exposed to the same inconvenience ; but it is likewise plain, that if a house be situated upon the slope of a hill, it will not be in any danger of smoke when the wind blows towards that side of the hill upon which it is situated ; for the current of air coming over the house top in the upward sloping direction, draws the smoke powerfully upwards along with its current from the chimney.

But it is also evident, that the same house will be liable to smoke when the wind blows in the contrary, or downward direction, as it will beat down upon the chimney and drive the smoke back into the house ; and the effect will be much heightened, if the doors and windows be chiefly in the lower side of the house.

These are the most general circumstances, arising from the situation of external objects, that prevent the free and regular ascent of smoke ; but there are many lesser and more temporary obstructions, which it is difficult either to recollect or enumerate : such as blasts of wind reflected from the sides of mountains, and coming down valleys with great impetuosity, occasioning, in particular situations, eddies, or whirlwinds of different sorts. In short, whatever in any measure disturbs the free motion of the air, is in danger of producing sudden gusts, which may occasion smoke. Therefore, whoever builds in a situation that is not altogether free, may lay his account for having some sudden gusts of smoke,

unless the chimney tops be so formed as to obviate such a result. There are some situations so much exposed to sudden gusts of wind, which is sometimes whirled round, sometimes beaten suddenly downwards, or as suddenly carried up again, that it is difficult to guard against every danger. In such situations, chimney tops close above, but having side spouts pointing both upwards and downwards at the openings, though coming out from the chimney tops at right angles, would be proof against any wind whatever.

We have thus considered, under three general heads, the circumstances tending to accelerate or retard the ascent of smoke in chimneys. But though all the circumstances may be reduced to one or other of these three classes, it may be proper to observe that, in many cases, circumstances belonging to all these classes may be combined in the same house, so as to augment the evil; which tends greatly to perplex those who attempt to cure smoky houses without being able to distinguish the causes. It, therefore, behoves every one who shall attempt this task, to habituate his mind to reflect on this subject, so as to be able readily to combine, or separate all the phenomena belonging to each of the classes. To enable him to do this more readily, the following rules will be of use.

CHAPTER V.

RULES TO DISTINGUISH THE CLASS OF CAUSES AS ABOVE, TO WHICH SMOKE IN ANY HOUSE MAY BE ASCRIBED.

I. IF smoke arises from a fault in the construction of the chimney or vent, the house will be perpetually pestered with smoke, and will be worst in calm weather.

II. If the house be not troubled with smoke in calm weather, or only when the wind comes from some particular quarter, and can then be cured by opening some door or window, the fault may be looked for in the distribution of the doors and windows of the house.—The only case in which it is difficult to distinguish whether it is owing to a fault of the chimney or the house, is when it proceeds from too much closeness of the apartment. But this may be ascertained by trying it in a calm; for if it proceeds from closeness, there will be no smoke in a perfect calm, if the doors are left open; whereas, if the smoking proceed from a fault in the chimney itself, it will still continue to smoke in calm weather, even when the doors are open.

III. When the smoke is occasioned by external causes, these can be in general seen; but it may be

likewise known by this, that it descends in sudden gusts, with great violence at times, even when no change is produced either by opening or shutting doors or windows.

By carefully attending to these few rules, there will be little danger of mistaking the cause from whence the disorder proceeds.

CHAPTER VI.

ON REMEDIES.

WHEN it has been ascertained, by the rules in the preceding chapter, to what class of smoky chimneys the particular case belongs, the next thing is to discover and apply such remedies as may be practicable under the circumstances, or as come nearest to the removing of such defects of construction or arrangement as may be found to exist in the particular case, after comparing it with the observations contained in chapters second, third, and fourth.

I. The remedy suggested by the first section of chap. ii. is often directly practicable to some extent, and always less or more, viz., that of lengthening the vent, by carrying it farther up at the top either by tile tops or additional building.

II. Where the vent has been found a great deal too narrow, it may sometimes be practicable, if in an outside gable wall, standing free of other buildings, to make an opening through it at the neck of the vent, above the fire-place, in its back part, and carry a new vent up the outside of the wall all its height.

III. Where that cannot be done, indirect remedies must be had recourse to, such as heightening the vent,

as already mentioned, or such of the others which follow, as may be most suitable.

IV. Where the vent is found too wide just above the fire, and to assume the proper dimensions too gradually, a contraction of building must be adopted to give it the form in that part recommended in chap. ii. sect. 3.

V. Where the principles of building recommended in sections 4, 5, and 6, of chap. ii. have not been attended to, no direct remedies can be applied. In such cases we must content ourselves with endeavouring to balance such disadvantages, by combining all the advantageous alterations suggested by such principles as come within our reach, which have already been or are subsequently to be noticed.

VI. Where the size and position of the fire itself, the proper construction of the fire-place immediately above it, the proper height of the opening from the mantel to the hearth, the thinness of the lower edge of the mantel and the position of the front bars of the grate in respect to it, the wideness between the jambs, have not been constructed according to sections 7, 8, 9, and 10, of chap. ii. the remedies are both practicable and easy. It is only necessary to observe here, that although where the vent itself is properly constructed, and other arrangements of rooms and doors have been strictly attended to, it would never be necessary; yet in order to counterbalance some of those insurmountable defects, it may be sometimes necessary to contract the sides of the opening from the jambs to the very bars of the grate, and to lower it from the mantel till it resembles the opening above the fire of a stove.

VII. Where the closeness of the apartment does not

furnish a sufficient supply of cold air to support the draught of the vent, the best remedy would be to have a small hole made in the wall, at the back of the chimney, and immediately underneath it, one end of which should communicate with the external air, and the other with the room in any place near the grate, and as low down as possible, through which a constant supply of air would be provided for the fire without the smallest inconvenience or trouble.

If this were practised, doors and windows might with safety be made much closer than usual, and our apartments rendered equally warm and comfortable, with a much smaller quantity of fuel than we use at present. For as the fire, in the ordinary way of constructing houses, is kept alive by a constant succession of cold air from the doors and windows rushing towards the chimney in all directions, the air of the room, which, if not cooled by this means, would quickly be heated to a great degree, is constantly kept cold in spite of the strong heat of a large blazing fire, which, at the same time that it scorches those parts of the body that are turned towards it, does not warm the parts that are turned away from it; and we experience at the same time a burning heat and a piercing cold, which is often productive of the most disagreeable effects. But if the fire were in this manner supplied with air, there would be less drawn from the crevices of the room, so that what was within would be soon warmed, and continue long so, even with a small degree of heat produced by the fire.

Perhaps in this case it might become necessary to carry off the foul air, by leading a pipe from the upper

part of the room reaching to the top of the house, by which means the air that had been rendered noxious by the smoke of candles or by respiration, would constantly escape, and its place be gradually supplied by fresh air from the opening at the grate. Ventilators are often used as a remedy in this case; but they are of more service for allowing the heated and rarefied air to escape, than for supplying the draught of the chimney with fresh air.

VIII. Where the principles of subdivision of houses, the situations of doors, windows, and passages, recommended in chap. iii., have not been followed in the construction of a house, and when smoke is produced in consequence, it will be indicated by the vent and fire-place, perhaps, being correctly constructed, or, at all events, by the second rule in chap. v.; in this case the only course is to find out what counter currents of air may be occasioned by opposite openings or other similar causes. It is impossible here to particularize these more than has been done in chap. iii.; but it may always be relied upon, that, when the above-mentioned rule applies, and when the state of the chimney itself is tolerably correct, such currents do exist either in the room or in some passage communicating with it; and, when discovered, whatever is practicable must be done to stop them, or, at least, so to alter their direction that they may rather assist than oppose the draught of the vent. It is, however, a very general mistake to apprehend, when houses are, from this cause, troubled with smoke, that it is occasioned by some external cause, and apply their attention to cure it, by altering the top of the chimney, which never can be of the smallest service

in this case. I would recommend a more particular attention to be paid to the situation of doors and windows than is generally given, especially in situations where they are exposed to any violent current of air in a particular direction, as in narrow lanes, where the wind is driven along with great rapidity.

IX. When smoke is evidently referrible to the situation of a house with regard to external and surrounding objects, the attention is to be directed first to such currents of air as these may occasion *within the house*, which are to be obviated by the means just referred to in the preceding article ; and then, to the action of the air at the top of the vent, by the nature of which the particular sort of chimney-top requisite will be indicated. There are a great variety of tops in use for all possible contingencies ; the difficulty lies, in all cases, in being able to hit upon the true cause of the smoke, so as to select what is most proper for the circumstances ; and in this respect there are many mistakes in practice, arising from want of experience.

X. The author has often succeeded in curing smoky chimneys, particularly in kitchens, by placing iron blowers in them, consisting of a plate, with a hole in it, fitted round the back of the fire, rising to the height of the opening of the fire-place, the hole in the centre, immediately behind the top of the fire, being oval, and about eighteen inches broad and nine high, into which is to be inserted an iron pipe, bent upwards behind the plate, and reaching several feet up the vent.

APPENDIX,

CONTAINING

EXTRACTS ON CHIMNEYS AND SMOKE,

AND

REMARKS ON CLEANING VENTS AND PREVENTING FIRES ;

TO WHICH ARE SUBJOINED

CERTIFICATES OF THE AUTHOR'S EXPERIENCE AND SUCCESS IN
CURING SMOKE.



APPENDIX, &c.

No. I.

Extract from the Edinburgh Encyclopædia.

ARTICLE—CIVIL ARCHITECTURE.

A CHIMNEY consists of an aperture in the wall, to receive a stove or grate, with fire to heat the apartment; and on this account it is also named a fire-place. From it a vacant space, named a vent, shaft, or flue, is carried, within the thickness of the wall, to the level of the top of the roof, to convey away the smoke. The bottom of the fire-place should be laid with square tiles, stone, marble, or an iron plate, in order to receive the cinders and ashes; this is termed the inner hearth. Upon a level with this, or a little above it, and immediately before the fire-place, a space equal in length to the breadth of the chimney, and about two feet in breadth, should be laid with the same sort of materials as the inner hearth; it is termed the *slab*, and is laid either in a wooden boxing, containing sand and mortar, or upon a flat brick arch which has been turned between the wall and a trimming-joint in the floor. The front and vertical sides of the chimney aperture are termed *jamb*s, and are composed of stone, marble, wood, or iron. The

part which reaches across the top of the aperture is called the *mantel*, and is of the same sort of materials as the jambs. As in thin walls, the part which the chimney occupies is projected into the room, in this, what is over the chimney is termed the *breast*. Within the fire-place, the parts which reach between the jambs and back, are named Covings. Where the space is contracted from the size of the fire-place to that of the flue, it is called the Gathering-wings or Throat. The portion of the chimney that rises above the roof is called the Chimney-top. When several flues, either in the wall or at the top, approach very near each other, the partitions between them are named *Withs*; and the whole is termed a Stack. In rooms of ordinary dimensions, the flues, in rough stone walls, are from 12 to 14 inches square; in hewn stone or brickwork, about 10 × 14 inches; but the section must be enlarged in rooms of large dimensions, kitchens, &c. As soot is apt to gather in the angles of square flues, the circular form is preferable. They should be made quite smooth within, and free of quick bendings. It is of advantage to have the flues of great height; but if raised much above the level of the roof, it is difficult to render them ornamental. Inigo Jones is the only British architect who has performed it with success.

As much of the comfort of an apartment depends upon its being free of smoke, and much economy in causing the heat to be reflected into the room, instead of suffering it to be unnecessarily absorbed by the materials, or dissipated in the flue, &c., great attention is necessary in fitting up the fire-place. For economy, stone which will stand the fire is preferable to metal.

The side covings should be levelled, or wholly circular ; and the opening at the back of the fire-place into the throat should not exceed 4 inches in breadth ; frequently $1\frac{1}{2}$ inches is sufficient. With register stoves this can be regulated to great advantage. The throat part should fall back from this aperture, and, in general, no air should be admitted into the throat but what passes over the fire ; it is, therefore, advisable to fit up the fire-place very accurately, and place the front of the grate forward to the line of the face of the wall of the apartment. In countries where stoves are used, it is customary to place them altogether before the face of the wall. This admits of much decoration, and also throws the greatest part of the heat into the room.

Chimneys have always been considered important features, but the style of decoration has varied greatly in different ages. In the Norman castles, they were frequently large, and accompanied by rude pillars, sculptures, and ornamental mouldings. After the revival of Roman architecture, the whole space between the fire-place and the ceilings, called the chimney-breast, was covered with architectural decorations of great labour and expense. Wood was succeeded by stucco work and ornamented pannels, to receive paintings ; but of late, these have been abandoned, and the chimney has been reduced into the smallest possible bounds, making it, for elegance, depend upon the marble dressings and highly polished and engraved steel register stoves.*

* The improved construction of stove grates introduced within these few years, has proved a great preventive of smoky chimneys.

No. II.

DR FRANKLIN'S OBSERVATIONS ON SMOKY CHIMNEYS, WITH HIS
REMEDIES FOR CURING THEM.

MANY are apt to think that smoke is, in its own nature and of itself, specifically lighter than air, and rises in it from the reason that cork rises in water. Smoke is, however, heavier than air, and is carried upwards only when attached to or acted upon by air that is heated, and thereby rarefied and rendered specifically lighter than the air in its neighbourhood.

Smoke being rarely seen, but in company with the heated air, and its upward motion being visible, though that of the rarefied air that drives it is not so, has naturally given rise to this error.

No form of the funnel of a chimney has any share in its operation or effect respecting smoke, except its height, the longer the funnel, if erect, the greater its force, when filled with rarefied and heated air, to draw in below and drive up the smoke ; if any one may, in compliance with custom, use the expression draw, when, in fact, it is the superior weight of the surrounding atmosphere that presses to enter the funnel below, and so drives up the smoke before it and the warm air it meets with in its passage.

What is it, then, which makes a smoky chimney,—that is, a chimney which, instead of conveying up all the smoke, discharges a part of it in the room, offending the eyes and damaging the furniture ?

The causes of this effect which have fallen under my observation amount to nine, differing from each other, and therefore requiring different remedies.

First. Smoky chimneys in a new house are such, frequently, from mere want of air. The workmanship of the rooms being all good, and just out of the workman's hand, the joints of the boards of the flooring and of the pannels of wainscotting are all true and tight ; the more so as the walls, perhaps not yet thoroughly dry, preserve a dampness in the air of the room, which keeps the wood-work swelled and close. The doors and sashes, too, being worked with truth, shut with exactness ; so that the room is as tight as a snuff-box, no passage being left open for air to enter, except the key-hole, and even it sometimes covered by a little dropping shutter.

Remedies. When you find, on trial, that opening the door or a window enables the chimney to carry up the smoke, you may be sure that want of air *from without* was the cause of its smoking.

It remains to be considered, how and where this necessary quantity of air from without is to be admitted, so as to be least inconvenient.

Easy and cheap methods, though not quite so perfect in themselves, are of most general utility ; and such are the following.

In all rooms where there is a fire, the body of air, warmed and rarefied before the chimney, is continually changing place and making room for other air that is to be warmed in its turn. Part of it enters and goes up the chimney, and the rest rises and takes its place near the ceiling. If the room be lofty, that warm air remains above our heads as long as it continues warm, and we

are little benefited by it, because it does not descend till it is cooler. Few can imagine the difference of climate between the upper and lower parts of such a room, who have not tried it by the thermometer, or by going up a ladder till their heads are near the ceiling. It is, then, among this warm air the wanted quantity of outward air is best admitted, with which being mixed, its coldness is abated, and its inconvenience diminished, so as to become less observable. This may be easily done, by drawing down about an inch of the upper sash of a window ; or if not moveable, by cutting such a crevice through its frame ; in both which cases, it will be well to place a thin shelf of the length to conceal the opening, and sloping upwards to direct the entering air horizontally along and under the ceiling. In some houses the air may be admitted by such a crevice made in the cornice or plaster, near the ceiling, and over the opening of the chimney. This, if practicable, is to be chosen ; because the entering cold air will there meet with the warmest rising air from before the fire, and the soonest tempered by the mixture. The same kind of shelf should also be placed here. Another way, and not a very difficult one, is to take out an upper pane of glass in one of your sashes, set in a tin frame, giving it two springing angular sides, and then replacing it with hinges below, on which it may be turned to open more or less above ; it will then have the appearance of an internal skylight. By drawing this pane in, more or less, you may admit what air you find necessary. Its position will naturally throw that air up to and along the ceiling.

A second cause of the smoking of chimneys, is their

opening in the room being too large, that is, too wide, or too high, or both. If there be a large opening to a chimney that does not draw strongly, the funnel may happen to be furnished with the air it demands from a partial current entering on one side of the opening, and, leaving the other side free of any opposing current, may permit the smoke to issue there into the room. Much, too, of the force of draught in a funnel depends on the degree of rarefaction in the air it contains, and that depends on the nearness to the fire of its passage on entering the funnel. If it can enter far from the fire on each side, or above the fire, in a wide or high opening, it receives little heat in passing by the fire, and the contents of the funnel are by no means less different in levity from the surrounding atmosphere, and its force in drawing consequently weaker.

Remedy. If you suspect that your chimney smokes from the too great dimensions of its opening, contract it by placing moveable boards so as to lower and narrow it gradually, till you find the smoke no longer issues into the room. The proportion so found will be that which is proper for the chimney, and you may employ the bricklayer or mason to reduce it accordingly. If, in large and elegant rooms, custom or fancy should require the appearance of a larger chimney, it may be formed of expensive marginal decorations in marble, &c. In time, perhaps, that which is fittest in the nature of things may come to be thought handsomest. But at present, when men and women, in different countries, show themselves dissatisfied with the forms God has given to their heads, waists, and feet, and pretend to shape them more perfectly, it is hardly to be expected

that they will be always content with the best form of a chimney. And there are some I know so bigoted to the fancy of a large noble opening, that, rather than change it, they would submit to have damaged furniture, sore eyes, and skins almost smoked to bacon.

Third. Another cause of smoky chimneys is too short a funnel. This happens necessarily in some, as where a chimney is required in a low building; for, if the funnel be raised high above the roof, in order to strengthen its draught, it is then in danger of being blown down, and crushing the roof in its fall.

Remedies. Contract the opening of the chimney, so as to oblige all the entering air to pass through or very near the fire; whereby it will be more heated and rarefied, the funnel itself be more warmed, and its contents have more of what may be called the force of levity, so as to rise strongly, and maintain a good draught at the opening.

If the low building be used as a kitchen, and a contraction of the opening therefore inconvenient, a large one being necessary, at least when there are great dinners, for the free management of so many cooking utensils;—in such case I would advise the building of two more funnels joining to the first, and having three moderate openings, one to each funnel, instead of one large one; when there is occasion to use but one, the other two may be kept shut up by sliding plates, and two, or all of them, may be used together when wanted.

Fourth. Another very common cause of the smoking of chimneys is their overpowering one another. For instance, if there be two chimneys in one large room, and you make fires in both of them, the doors and win-

dows quite shut, you will find that the greater and stronger fire shall overpower the weaker, and draw air down its funnel to supply its own demand ; which air descending in the weaker funnel will draw down its smoke, and force it into the room. If, instead of being in one room, the two chimneys are in two different rooms, communicating by a door, the case is the same whenever that door is open. In a tight house, I have known the kitchen chimney on the lowest floor, when it had a great fire in it, overpowering any other chimney in the house, and draw air and smoke into its room, as often as the door was opened, communicating with the staircase.

Remedy. Take care that every room have the means of supplying itself from without, with the air its chimney may require, so that no one of these may be obliged to borrow from another, nor under the necessity of lending. A variety of these means have been already described.

Fifth. Another cause of smoking is, when the tops of chimneys are commanded by higher buildings or by a hill, so that the wind blowing over such eminence falls like water over a dam ; sometimes almost perpendicularly on the tops of the chimneys that lie in its way, and beats down the smoke contained in them.

Remedy. That commonly applied to this is a turning-cap made of tin or plate iron, covering the chimney above and on three sides, open on one side, turning on a spindle, and which, being guided or governed by a vane, always presents its back to the current. This, I believe, may be generally effectual, though not certain, as there may be cases in which it will not succeed. Raising

your funnels, if practicable, so as their tops may be higher, or at least equal to the commanding eminence, is more to be depended on. But the turning-cap being easier and cheaper should first be tried. If obliged to build in such a situation, I would choose to place my doors on the side next the hill, and the backs of my chimneys on the farther side, for then the column of air falling over the eminence, and of course pressing on that elbow, and forcing it to enter the doors on that side, would tend to balance the pressure down the chimneys, and leave the funnels more free in the exercise of their functions.

Sixth. There is another case of command, the reverse of the last-mentioned ; it is where the commanding eminence is farther from the wind than the chimney commanded. Suppose a building, whose side happens to be exposed to the wind, and forms a kind of dam against its progress. The air obstructed by this dam will, like water, press and search for passages through it ; and finding the top of a chimney below the top of the dam, that is, lower than the top of the house, it will force itself down that funnel, in order to get through by some door or window open on the other side of the building. And if there be a fire in such chimney, its smoke is, of course, beat down, and fills the room.

Remedy. I know of but one, which is, to raise such funnel higher than the roof supporting it, if necessary, by iron bars ; for a turning-cap, in this case, has no effect, the dammed-up air pressing through it, in whatever position the wind may have placed its opening.

Seventh. Chimneys, otherwise drawing well, are sometimes made to smoke by the improper and inconvenient

situation of a door. When the door and chimney are on the same side of a room, if the door, being in a corner, is made to open against the wall, which is common, as being there, when open, more out of the way, it follows that when the door is only opened in part, a current of air rushing in passes along the wall into and across the opening of the chimney, and flirts some of the smoke into the room. This always happens more certainly when the door is shutting, for then the force of the current is augmented, and becomes very inconvenient to those who, warming themselves by the fire, happen to sit in its way.

The remedies are obvious and easy. Either put an intervening screen from the wall round great part of the room to the fire-place ; or, which is perhaps preferable, shift the hinges of your door, so as it may open the other way, and when open throw the air along the wall.

Eighth. A room that has no fire in its chimney is sometimes filled with smoke which is received at the top of its funnel, and descends into the room. Funnels without fires have an effect according to their degree of coldness or warmth, on the air that happens to be contained in them. The surrounding atmosphere is frequently changing its temperature. If, after a warm season, the outward air suddenly grows cold, the empty warm funnels begin to draw strongly upward ; that is, they rarefy the air contained in them. The surrounding atmosphere is continually changing its temperature ; but stacks of funnels, covered from winds and sun by the house that contains them, retain a more equal temperature. If, after a warm season, the outward air

suddenly grows cold, the empty warm funnels begin to draw strongly upward, that is, they rarefy the air contained in them, which, of course, rises, cooler air enters below to supply its place, is rarefied in its turn, and rises ; and this operation continues till the funnel grows colder, or the outward air warmer, or both, when the motion ceases. On the other hand, if, after a cold season, the outward air suddenly grows warm, and, of course, lighter, the air contained in the cool funnels, being heavier, descends into the room ; and the warmer air which enters their tops being cooled in its turn, and made heavier, continues to descend ; and this operation goes on till the funnels are warmed by the passing of warm air through them, or the air itself grows cooler. When the temperature of the air and funnels is nearly equal, the difference of warmth in the air between day and night is sufficient to produce these currents ; the air will begin to ascend the funnels as the cool of the evening comes on, and this current will continue till perhaps nine or ten o'clock next morning, when it begins to hesitate ; and, as the heat of the day approaches, it sets downwards, and continues so till evening, when it again hesitates for some time, and then goes upwards constantly during the night, as before-mentioned. Now when smoke issuing from the tops of neighbouring funnels passes over the tops of funnels which are at the time drawing downwards, as they often are in the middle part of the day, such smoke is of necessity drawn down into these funnels, and descends with the air into the chimney.

The remedy is, to have a sliding plate, that will shut perfectly the offending funnel.

Ninth. Chimneys which generally draw well, do, nevertheless, sometimes give smoke into the rooms, it being driven down by strong winds passing over the tops of their funnels, though not descending from any commanding eminence. This case is most frequent where the funnel is short, and the opening turned from the wind. It is the more grievous when it happens to be a cold wind that produces the effect; because, when you most want your fire, you are sometimes obliged to extinguish it. To understand this, it may be considered that the rising light air, to obtain a free issue from the funnel, must push out or oblige the air that is over it to rise. In a time of calm or of little wind this is done visibly, for we see the smoke that is brought up by the air rise in a column above the chimney. But, when a violent current of air, that is, a strong wind, passes over the top of a chimney, its particles have received so much force, which keeps them in a horizontal direction, and follow each other so rapidly, that the rising light air has not strength sufficient to oblige them to quit that direction, and move upwards to permit its issue. Add to this, that some of the current passing over that side of the funnel which it first meets with, have been compressed by the resistance of the funnel, may expand itself over the flue, and strike the interior opposite side from whence it may be reflected downwards.

Remedies. In some places, particularly in Venice, where they have not stacks of chimneys, but single flues, the custom is, to open or widen the top of the flue, rounding in the true form of a funnel, which some think may prevent the effect just mentioned; for the wind blowing over one of the edges into the funnel, may be

slanted out again on the other side by its form. I have had no experience of this ; but I have lived in a windy country, where the contrary is practised, the tops of the flues being narrowed inwards, so as to form a slit for the issue of the smoke, long as the breadth of the funnel and only four inches wide. This, however, did not always succeed ; for when the wind was at north-east, and blew fresh, the smoke was forced down by fits into the room I commonly sat in, so as to oblige me to shift the fire into another. The position of the slit of this funnel was indeed north-east and south-west. Perhaps if it had been laid across the wind, the effect might have been different. But on this I can give no certainty. It seems a matter proper to be referred to experiment. Possibly a turncap might have been serviceable, but it was not tried.

I have thus gone through all the common causes of the smoking of chimneys that I can at present recollect, as having fallen under my observation ; communicating the remedies that I have known successfully used for the different cases, together with the principles on which both the disease and the remedy depend, and confessing my ignorance wherever I have been sensible of it. For many years past, I have rarely met with a case of a smoky chimney which has not been solvable on these principles, and cured by these remedies, where people have been willing to apply them ; which is, indeed, not always the case ; for many have prejudices in favour of the nostrums of chimney doctors and fumists, and some have conceits and fancies of their own, which they rather choose to try, than to lengthen a funnel, alter the size of an opening, or admit air into a room, however neces-

sary ; for some are as much afraid of fresh air as persons in the hydrophobia are of fresh water. I, myself, had formerly this aërophobia, as I now account it ; and dreading the effects of cool air, I considered it as an enemy, and closed with extreme care every crevice of the rooms which I inhabited. Experience has convinced me of this error. I now look upon fresh air as a friend ; I even sleep with an open window. I am persuaded that no air from without is so unwholesome, as the air within a close room, that has been often breathed and not changed.

MISCELLANEOUS OBSERVATIONS.

Chimneys, whose funnels go up in the north wall of a house, and are exposed to the north winds, are not so apt to draw well, as those in a south wall ; because when rendered cold by these winds they draw downwards.

Chimneys enclosed in the body of a house are better than those whose funnels are exposed in cold walls.

Chimneys in stacks are apt to draw better than separate funnels ; because the funnels that have constant fires in them, warm the others in some degree that have none.

One of the funnels, in a house I once occupied, had a particular funnel joined to the south side of the stack, so that three of its sides were exposed to the sun in the course of the day, viz., the east side during the morning, the south side in the middle part of the day, and the west side during the afternoon, while its north side was sheltered by the stack from the cold winds. This funnel, which came from the ground floor, and had a

considerable height above the roof, was constantly in a strong drawing state, day and night, winter and summer.

Blackening of funnels exposed to the sun, would probably make them draw still stronger.—*Franklin*.

FOUL CHIMNEYS.—A few pinches of sulphur, thrown at short intervals upon the fire in the grate, will speedily extinguish the most raging fire in a chimney. The sulphurous vapour has also the advantage of pervading the crevices and ramifications of the chimney, and completely finishing the combustion. A pound of sulphur has effectually put out, in a few minutes, a fire in a tall chimney, when the flame rose three or four yards above the top. A wet cloth should be hung before the fire-place.—*Annales de Chimie*.

No. III.

From an Edinburgh Paper.

MR TREDGOLD, in his work on warming and ventilating apartments, has given the following rules for proportioning the upper orifices of chimneys to their heights and the magnitude of the fire-places.

Multiply by 17 the length of the fire-place in inches ; divide the product by the square root of the height in feet of the chimney above the fire—the quotient will be the area of the upper orifice in square inches. Thus, if the fire-place be 15 inches wide, and the height of the chimney be 49 feet, we shall have $17 \times 15 = 36\frac{1}{2}$

square inches nearly, which is a 7 rectangle of 6×6 inches, or a circle of nearly 7 inches in diameter. In chimneys already existing, the upper orifices may be contracted to their proper size by Parker's Roman cement. The contraction of the lower end of the vent above the fire should be nearly the same as the upper orifice, and the throat, or lowest opening, should not exceed the length of the bars.

The length of the front of the fire should be an inch for every foot in the length of the room, and the depth one half the length.

If the length of the chamber should be such as to require a grate more than 30 inches long, two fire-places should be constructed.*—*Edinburgh Journal*.

Down to the reign of Queen Elizabeth, the greater part of the houses in considerable towns had no chimneys; the fire was kindled against the wall, and the smoke found its way out by the roof, the door, or the windows. That chimneys were not known from the tenth to the thirteenth century, may be presumed from the continuance of the custom of the curfew, which arose thus:—In what are usually termed the middle ages, the fires in houses were made in a cavity in the centre of the floor, over which there generally was an opening in the roof for the escape of the smoke; and when the fire was out, or the family retired to rest, the place in which it was made was closed by a cover. In those days a law

* These rules seem rather arbitrary—the Author gives them as he received them, without any comment.

was almost universally established on the Continent, that fires should be extinguished, and the family be all at home, at a certain hour of the evening, which was notified by the ringing of a bell; that in this country was called the curfew, and was evidently derived from the French *couvre feu*. This law was introduced into England by William the Conqueror, to prevent nocturnal assemblages of the people; and, although it was abolished in the following century by Henry the First, it yet remained in force long after in many parts of Europe. . . . Chimneys are, indeed, mentioned, for the first time of which there is any record, in the very year of the edict to which we have just alluded. . . . Whether the ancients were acquainted with the use of chimneys, is a question that has occasioned much learned controversy; but, after the closest examination, it appears to be clearly decided in the negative. While chimneys were erected in the wide and simple manner in which they are still to be found in some old mansions, they are easily cleaned by the common house servants; but when the flues were constructed in a narrower and more complex form, the operation was rendered difficult, and the employment became the occupation of regular chimney-sweepers, &c.—*Chambers' Journal*.

No. IV.

REMARKS ON CLEANING CHIMNEYS, AND PREVENTING DAMAGE BY
FIRE.

THE author has had long experience in cleaning chimneys, having, for many years, kept a number of men for that purpose ; and having never employed any other machine or means of cleaning than the rope and broom, he has uniformly found it perfectly sufficient and safe in all cases; and is quite convinced, that no other method hitherto practised, is either so effectual or so safe : on the contrary, the destructive effects of Smart's machine, which has long been in use by chimney-sweepers in Aberdeen, has often fallen under his observation, and he has no doubt but that its use may have been, and will be, the remote but sure cause of much destruction of property, and of many fires, under circumstances where timber is used at no great distance from the vents, as in battening and lathing brick walls containing vents. He has met with instances of the bridges and partitions, between several vents in the same wall, being destroyed by the use of that machine, as well as of chimney tops being knocked off by it, and the building much injured. He is well aware, that from this cause much property is, at this moment, in great risk of fire ; for when the partitions between vents are broken through, lodgments of soot will be collected in the vacuities, and in vents where no fire is used. When this is the case, it requires only the accident of such a

chimney taking fire to place the whole buildings connected with it in the most imminent danger. He would, therefore, earnestly recommend to all proprietors of houses, to let them to tenants expressly on these conditions : that the rope and broom only is to be used in cleaning the vents, as being well known, from long experience, to be perfectly harmless to the walls, as well as effectual in cleaning, and at least not more expensive, than the other methods recently invented.

While hinting at the danger of fires having originated by the bungling and destructive modes of cleaning chimneys, he may take the liberty of mentioning here, that in the course of his practice in pulling down and altering the construction of vents, fire-places, and the settings of grates, he has met with so many instances of carelessness in filling up the back part of the grates, in setting with combustible materials, in the contiguity of wood to vents and fire-places, where parts of it have been found in a charred state, that he feels entirely convinced that more fires are occasioned from such causes than arise from those accidents to which they are commonly attributed, such as sparks and snuffs of candles, communicating with furniture or clothes, which would generally take fire instantly, and be in a blaze at once ; whereas, fires arising in the battens and lath behind grates, or from collections of soot in confined situations; where little air can be admitted, would continue to smoulder for perhaps several days, till at last making their way to the air at some point nearer to the surface, being already strong and extensive, would, on receiving air, immediately burst out with irresistible violence. The fires that so recently destroyed the Par-

liament Houses were confessedly originated by the flues being overheated and contiguous to wood, but very probably, in reality, by collections of soot taking fire, which had accumulated in vacuities occasioned by some destructive apparatus, or new discovery used in cleaning them.

Were proprietors of houses, intended to be let, to place fixture grates in them at first, when they would be set, free of any of those combustible materials, and more substantial, much risk would be avoided ; besides the destruction of paper, paint, and plaster, occasioned by tearing out of grates and putting in others of different constructions. While an annual source of destruction and danger to the landlord's property would thus be done away with, a large yearly expense would be saved to the tenant, who would live in greater security from danger by fire. Smoke, also, might be prevented from this cause, as it is not unfrequently occasioned by grates being improperly set in chimneys which are otherwise not very perfectly constructed, and which would have required the utmost attention and experience in setting grates in them so as to avoid occasioning smoke.

The author will conclude these hasty remarks with an extract from Mr Beaumont's "Hints on preventing damage by Fire," as noticed in the Preface. "One of the most fruitful sources of accidents in common buildings in the country is, a *bearer of wood* for the chimney breast ; this ought always to be of iron ; for cheapness a bit of wood is used ; and when it fires, which it seldom fails to do at one time or another, the insurance office is required to make all good, and, to prevent a recurrence of accident, the office is expected to supply

the iron bar, which the builder was too parsimonious to provide. This is neither fair nor legal. Then, as if courting conflagration, timbers are laid close to flues, and sometimes even within the flue itself. The mortice pecked in the four-inch front of a flue to receive the bird's mouth end of the small hearth trimmers, and also the plugging for grounds, frequently break into the flue, and ensure a firing of the house the first time the soot takes fire. Trimmers, joists, rafters, and girders, protruded through the sides of flues, and even when lodged against the sides of flues, occasion numerous accidents. . . . The danger from fire and the instability of brickwork, are greatly increased by a practice among scamping workmen, of leaving hollow places, called pockets, in their walls; and in using only so much mortar, in laying their bricks, as gives a fair joint to the eye, leaving all behind hollow. The hollows get filled with soot, and when a fire takes place in an adjacent flue, the sooty chinks form a train which sets the building on fire. There is no legal penalty against this shameful fraud on the employer or house purchaser. . . . A minor cause of alarm sometimes arises from the setting of block chimney-pieces, in such a manner as to leave a communication between the hollow of the chimney-piece and the flue, in which hollow the soot gathers, and at length takes fire; but a more frequent cause of the same kind consists in the grate being set hollow behind. In this receptacle the soot falls and collects for a length of time, until it reaches the middle of the grate, when, upon the back becoming red hot, it lights the heap, and produces such an intense fire as to endanger the adjacent wood work. Another mode of

doing mischief arises from filling up the back of the grate with combustible rubbish, cinders, ashes, and coal, from the dust-bin ; and the workman's sweepings, if any, including shavings and pieces of wood, seldom come amiss to the bricklayer, provided they are near hand. We were called to a raging fire at the back of a register stove, on one occasion, when, upon removing the grate, it was discovered that the whole vacuity behind was filled up with several bushels of simple unadulterated coals. Upon inquiry, it turned out that the bricklayer, having been referred to the dust-bin for rubbish, and finding it empty, had directed his Pat. to basket away from the coal-cellar !

“ Firing from alterations in flues, and additional flues erected in old buildings, are very common. The workmen must be, of necessity, somewhat in the dark as to the precise layings of adjacent timber ; but the indifference with which they disregard the contiguity of timber which they see, or know of, is frequently remarkable. Additional flues, to communicate with the kitchen flue, are continually required for hot plates, boilers, and ovens, and a slant, of six or eight feet in length, generally forms the connexion with the kitchen flue ; but, to make the projection as little unsightly as may be, as well as to get a support for the work, it is common to cut a chase in the wall ; the bond timber, in doing this, is frequently laid bare, but many workmen are so culpable as to make this exposed timber one side of their flue, or if they daub over it a bit of tile or slate, it is deemed an ample sacrifice to prudence. But the fires in those furnaces, and the short flues from them, are

very powerful. They are sure to fire adjacent wood work, unless a sufficiency of brick work intervene.

“Iron stoves set on a wood floor, and having iron pipes, are always more or less dangerous. It is thought enough to have a sheet-iron fender to set the stove upon; or if an additional sheet of iron, or lead, or slates, be placed between the fender and the boards, it is deemed being particularly careful; but more is necessary to be secure. We must look forward to some one taking the burning coals out of the stove, and putting them on the iron plate below the stove. These coals may burn fiercely, and as the boards underneath will be dry and hot, a little fire will ignite them. The iron pipes to these stoves are full of danger, unless they are carefully attended to. When they are not in use, particularly if much soot be left in them, they attract moisture and are rapidly oxidized. Then, when they become filled with soot, and the soot takes fire, it burns fiercely, and the fire drops through the rust holes and the joints; and if these droppings of fire occur between a wainscoting or a battening and a wall, at the hole where the pipe enters the brick flue, it is likely to set the house on fire. This danger is more imminent if the pipe passes through a floor, or lath and plaster partition, unless due precautions are used; and when the pipe is carried over goods that might take fire if a spark falls on them, the hazard is considerable.

“Descending iron flues, from open fire-places in cast-iron stoves, set up in shops and halls, are productive of frequent firings; whether they are conducted through the flooring, and along the ceiling of the room beneath,

to an adjacent chimney, or are carried between the joists to such chimney, or just over a wood floor, they are full of danger ; but the hazard of running them between the floor and ceiling is the most imminent and unwarrantable. Say what they may of surrounding the flue with incombustible materials, no fire can be made safe within a few inches of wood work. It is pretended, by some of the venders of these dangerous and expensive stoves, that they burn their own smoke. They do no such thing. They carry away their own heat ; and as a stronger fire must be used to force a draught through a descending than an upright flue, more smoke is raised, and the heat is more rapidly carried away through such stoves and flues, than from a common grate or close stove. They wear the look of warmth to the eye, but deny the reality of warmth to the body. They are expensive of themselves, wasteful of fuel, and productive of dirt and danger."

The author of the pamphlet from which this long quotation is made, is surveyor to the County Fire Office, London, and must, consequently, have considerable experience of this subject. The author refers to this quotation as a high authority, in corroboration of what he has advanced regarding cleaning vents and flues, and will now take leave of his readers, by again reminding such of them as have houses to build, to be extremely careful of the construction of every thing connected with those useful though dangerous parts of a building—the vents and fire-places.

No. V.

The author has had the honour to be employed as a smoke-curer by many noblemen and gentlemen in the north of Scotland, among whom he may mention, as having approved of his operations in that capacity, his Grace the late Duke of Gordon, the Right Hon. the Earl of Aboyne, the Right Hon. Lord Saltoun, Right Hon. Lord Kennedy, Sir Robert Burnett of Crathas, Sir R. D. Horn Elphinstone of Logie Elphinstone, Sir Charles Leslie, Sir Alexander Bannerman, Hon. General Duff of Dalgetty, General Hay of Rannes, Major Taylor of Rothiemay, Sir Harry Niven Lumsden of Auchindoir, Thomas Gordon, Esq. of Cairness, John Menzies, Esq. of Patfoddels, William M'Kenzie, Esq. of Pitrichie, Col. Grant, Cullen House, Col. Wood, Dee Bank, E. M. M'Dowall Grant, Esq. of Arndilly, Robert Grant, Esq. of Monymusk, James Gordon, Esq. of Craig, Major Robert Duff, Elgin, A. Scott, Esq. of Craibston, Capt. William Gordon, Aberdeen Militia, Robert Robertson, Esq. of Boddam, J. Farquharson, Esq. of Haughton, H. D. Forbes, Esq. of Balgownie, the late Mr Garden, of Troup, Rev. Mr Grant, Methlick, L. D. Brodie, Esq. of Burgie, Rev. Mr Leslie, Longbride, Rev. Mr M'Kay, of Rofford, George Leslie, Esq. of Rothie, Rev. Mr Hay, Forbes, Rev. Mr Wilson, Aberdeen, Dr Charles Skeen, Aberdeen, James Brand, Esq. of the Aberdeen Bank, &c. &c. &c. He takes this opportunity of submitting to the public a few copies out of many of the testimonials in his favour, which he has received from those who have employed him.

CERTIFICATES.

1.—*From his Grace the late DUKE OF GORDON.*

That the bearer, George Silver, has been employed here by the Duke of Gordon in the way of his profession; and that he has succeeded in curing several smoky chimneys, is attested by me,

(Signed)

JAMES HAY.

GORDON CASTLE, *July 29, 1823.*2.—*From the Right Hon. the EARL OF ABOYNE.*ABOYNE CASTLE, *July 12, 1829.*

George Silver, curer of smoke, residing in Aberdeen, has been employed by me to cure the Mason Lodge of Charlestown of Aboyne, which smoked to excess. There were also other chimneys in the house which did not vent well. I think it but justice, therefore, to say, that he has completely succeeded in curing the said Lodge of smoke; and I can recommend him to any family who may require his services, as a person superior in his business.

(Signed)

ABOYNE.

3.—*From GENERAL BURNETT, Banchory Lodge.*BANCHORY LODGE, *Oct. 2, 1830.*

I hereby certify that George Silver has perfectly cured a chimney, for me, of smoking, on which a number of experiments had been tried without success.

(Signed)

WILLIAM BURNETT.

4.—*From* SIR CHAS. A. LESLIE, *Findrassie*.

George Silver, curer of smoke, Aberdeen, was employed by me to try his art on the kitchen chimney of Findrassie House, which, notwithstanding various previous alterations, smoked to such a pitch as to make it almost uninhabitable; he has perfectly succeeded in freeing the kitchen of smoke, as it now vents equally well with any other chimney in the house. I have no hesitation in recommending him to those who may require his assistance, as one skilled in his business.

(Signed) CHAS. A. LESLIE.

FINDRASSIE HOUSE, *July 4, 1821.*

5.—*From* CAPT. WM. GORDON, *Aberdeen Militia*.

ABERDEEN, *30th Jan., 1828.*

After a month's trial, I find that my kitchen vents to my satisfaction; and also declare, that before Mr George Silver cured the vent, the house was not fit to be inhabited on account of smoke.

(Signed) W. GORDON.

6.—*From* M. E. M'DOWALL GRANT, *of Arndilly*.

This is to certify that Mr Silver, smoke-doctor, has completely cured the kitchen-chimney at Arndilly of smoking, and it now vents as freely as it is possible to do.

(Signed) M. E. M'DOWALL GRANT.

ARNDILLY HOUSE, *4th Aug., 1821.*

7.—*From* L. DUNBAR BRODIE, Esq. of *Burgie*,

TO WHOM IT MAY CONCERN.

The bearer hereof, George Silver, curer of smoke, residing in Aberdeen, has been employed by me to try his skill upon the kitchen chimney of my house at Burgie, which smoked to such a degree as to occasion almost total darkening. There were also other chimneys in the house that did not vent well. I think it is but justice to the bearer to say, that he has completely succeeded in curing my house of smoke, and I can safely recommend him to any family who may require his services, as a person superior in his business.

(Signed) LEWIS DUNBAR BRODIE.

BURGIE, *by Forres*, 8th Feb. 1821.

8.—*From* GEORGE LESLIE, Esq. of *Rothie*.

I had occasion to employ the bearer, George Silver, as a smoke-doctor, and, to do him justice, I must say that he completely cured my kitchen of smoke.

(Signed) GEO. LESLIE.

ROTHIE, *July*, 1823.

9.—*From* MAJOR ROBERT DUFF, *Elgin*.

I do hereby certify, that Mr George Silver, smoke-doctor, was employed by me to cure my kitchen chimney; that he did the same most completely, as witness my hand.

(Signed) ROBERT DUFF.

LADYHILL, *Elgin*, 4th March, 1823.

10.—*From* JOHN FRASER, Esq. *Cullen House.*

CULLEN, *5th Aug.*, 1824.

Above two years ago I employed Mr Silver to repair my kitchen vent. For many years previously it had been a source of continual annoyance with smoke, but was completely cured by Mr Silver, and has given the greatest satisfaction ever since.

(Signed)

JOHN FRASER.

11.—*From* ROBT. ROBERTSON, Esq. *of Boddam.*

These certify that the bearer, George Silver, smoke-doctor, in Aberdeen, was employed by me to cure an outer kitchen chimney vent, which smoked considerably, and that he cured the same most effectually; as witness my hand at Peterhead, the eighteenth day of November, eighteen hundred and twenty-two years.

(Signed)

ROBT. ROBERTSON.

12.—*From* SIR ALEX. BANNERMAN, *Aberdeen.*

George Silver *altered* and CURED one of the vents in my house, that smoked in particular winds.

(Signed)

A. BANNERMAN.

ABERDEEN, *April*, 1825.

13.—*From the* REV. MR M'KAY, *of Rafford.*

These certify that Mr George Silver was employed

by me in curing my house of smoke, and that he was successful in every respect; at the same time I considered his charges to be extremely moderate.

(Signed) GEORGE M'KAY,
RAFFORD, April 20, 1821. Minister of Rafford.

14.—From the REV. MR GRANT, Methlick.

Methlick, 28th May, 1818.

Mr Geo. Silver, slater, and curer of smoke, Aberdeen :

Sir,—As you are anxious to know what effect your operations had on my kitchen chimney, I have the satisfaction to inform you, that since you were here in the month of January last, we have had no smoke in the kitchen, except when extraordinary gales of wind happened, and even then it was so moderate that it need scarcely be mentioned; whereas, previous to your being employed, we were not many successive days without the whole manse being annoyed with smoke, and scarcely any living in the kitchen when the wind blew over the manse either from the south-east or north-west. I consider myself much obliged to the person who recommended you to me; for many plans had been adopted, and much expense incurred, previously to your being employed, and all to no good purpose. You are at liberty to make what use you please of this letter, and

I am, Sir, your obedient servant,

(Signed) LUDOVICK GRANT.

15.—*From* JOHN GORDON, Esq. *of* Craig.

CRAIG, *Sept.* 1, 1827.

Mr George Silver, mason and smoke-curer, has superintended the erection and finishing of a chimney at Craig, in a very difficult situation, and the work has been contrived and executed much to my satisfaction. I think Mr Silver understands his business perfectly, and is a very ingenious tradesman.

(Signed)

J. GORDON.

16.—*From* ALEXANDER LEITH, Esq. *of* Freefield.

FREEFIELD, *6th* July, 1831.

I hereby certify that Mr Silver has cured the kitchen and several other chimneys here of smoking.

(Signed)

ALEX. LEITH.

17.—*From* ALEX. BLAIKIE, Esq. *Banker, Aberdeen.*

This is to certify that Mr George Silver succeeded in curing of smoke the kitchen in my house, which for years had annoyed me, and was declared by others in the trade to be incurable.

(Signed)

ALEX. BLAIKIE.

3d Nov., 1831.

39, Marischal Street.

18.—*From* JAMES SHEARER, Esq. *Buchromb.*

To George Silver, Smoke-doctor :

I hereby certify, that you have cured my chimney of

smoke; and, although your operations took place three years ago, there has been no return of it.

(Signed) JAMES SHEARER.

BUCHROMB, 29th Oct., 1831.

19.—*From the* REV. MR HOYES, *Forres.*

To Mr George Silver, Smoke-doctor, Aberdeen.

Sir,—I beg to say that I am perfectly satisfied with the job, and I look upon what I have paid you as well laid out: your operations have succeeded very well.

I remain yours, &c.,

(Signed) WILLIAM HOYES.

Manse of Forres, 30th Nov. 1826.

20.—*From* COL. FORBES, *Aberdeen.*

Silver Street, 17th April, 1834.

Sir,—I am glad to inform you that the chimney you cured for me, which was intolerably smoky, is now giving entire satisfaction, and, as your experience in that line is well known, I am convinced, that were gentlemen building houses to employ you to superintend the construction of chimneys, in the course of building, so as to save any risk of trouble and expense afterwards, it would generally be much for their interest. As I suggest this with that view, as well as for your own advantage, you are at liberty to publish it if you are inclined.

I am, Sir, your obedient servant,

(Signed) D. FORBES.

Mr G. Silver, Smoke-curer.

21.—*From WILLIAM WHITE, Esq. Aberdeen.*

Messrs Adam and Anderson, Advocates.

Dear Sirs,—Mr Silver has cured the three chimneys of smoke.

Yours, faithfully,

(Signed) WILLIAM WHITE.

N. B.—The chimneys referred to in this certificate were desperate.

22.—*From T. LEGGETT, Esq. Millbank.*

MILLBANK, 14th Oct., 1833.

Sir,—After many plans had been tried, and much expense laid out, to no good purpose, in attempting to cure my kitchen-chimney of smoke, I employed you, and must give you my unqualified recommendation for the great judgment you displayed, and the judicious workmanship you executed, in effecting a perfect cure at a moderate expense.

(Signed) THEOP. LEGGETT.

Mr George Silver, Aberdeen.

23.—*From ROBERT INNES, Esq. Newton.*

NEWTON, 26th April, 1833.

Mr George Silver,

Sir,—After an ample trial, I hereby certify that your operation on the new kitchen-chimney at the Barnyards of Newton, has succeeded uncommonly well, not only in giving additional heat and accommodation to the ser-

vants, but perfectly curing the said chimney of smoke, which before was insufferable with that nuisance.

I am, Sir, your most obedient Servant,

(Signed) ROBERT INNES.

24.—*Another from J. GORDON, Esq. of Craig.*

CRAIG, 4th Oct., 1823.

Sir,—As you wish me to certify my opinion of your operations last year at Craig, I readily state, for the information of all whom it may concern, that I believe you to be a very skilful workman. When I applied to you, both my house kitchen and farm kitchen smoked occasionally, to a considerable degree; and, by your operations, those chimneys are now cured, and vent freely.—I am, &c.

(Signed)

J. GORDON.

25.—*From Messrs MUNRO & GRANT, Aberdeen.*

ABERDEEN, 16th Nov., 1835.

We hereby certify that the chimney vents of the shop occupied by us in Union Street, have been cured of smoke, since lately repaired, by Mr George Silver.

(Signed)

MUNRO & GRANT.

26.—*From the REV. MR LESLIE, Longbride.*

LONGBRIDE MANSE, Feb. 8, 1821.

Dear Sir,—Notwithstanding the principles which

several distinguished philosophers have ascertained, as effectual for correcting the nuisance of smoke in dwelling-houses, yet, in practice, these principles are so entirely disregarded, that the nuisance is frequently to be suffered; and it is generally in this country believed, that its removal by all the known operations is quite contingent.

I have, however, to certify in your favour, which with much cordiality I hereby do, that you discovered the cause which occasioned that nuisance in this house, which I am persuaded that none of the philosophers, who have attended to this object, could have done; and that you, thereupon, adopted the measures upon those principles which have certainly removed the nuisance: and I have reason to believe that you can, in general, apply these principles so as the removal of the nuisance will not be contingent: and wherever this nuisance is complained of, I would recommend to apply to you for its removal. And with best wishes for your continued success in this and in all other good things,

I am, Sir, your most obedient Servant,

(Signed) WILLIAM LESLIE.

To Mr George Silver, Aberdeen.

27.—*From* A. SCOTT, Esq. of *Muirish*.

These are to certify, that Mr George Silver cured our kitchen chimney of smoke; and I therefore recommend him to any person requiring his skill.

(Signed)

A. SCOTT.

MUIRISH, *April* 11, 1824.

28.—*From Gilcomston Brewery Company, Aberdeen.*

GILCOMSTON BREWERY, 9th Dec., 1822.

We certify that Mr George Silver, smoke-doctor, cured our counting-house chimney of smoke.

For Gilcomston Brewery Co.

(Signed)

GEO. ELSMIE.

29.—*From MR JAMES CRUICKSHANK, Aberdeen.*

Aberdeen, 2d April, 1822.

This is to certify, that Mr George Silver has effectually cured my chimney of smoke; and I have never had such a comfortable time all the three years I have been in the house.

For JAMES CRUICKSHANK,

(Signed) WM. LAWSON, *Grandson.*

30.—*From JAS. DAVIDSON, Manufacturer, Aberdeen.*

Aberdeen, 14th March, 1822.

Sir,—As you are anxious to know what effect your operations had on my kitchen chimney at Burnside, I have the satisfaction to inform you that it is completely cured of smoke, after an ample trial, and recommend you to any person who may have occasion for your services. You are at liberty to make what use you please of this letter, and

I am, Sir,

Your most obedient Servant,

(Signed)

JAMES DAVIDSON.

31.—*From* ROBERT WILSON, *Steward of the Methodist Chapel, Aberdeen.*

UPPER KIRKGATE, *Aberdeen, March 15, 1822.*

Sir,—After a fair trial, during the most tempestuous weather we have experienced this season, I have the satisfaction to inform you, that your operations on the chimney of the vestry attached to the Methodist Chapel, Aberdeen, have proved most effectual.

It is well known, that in consequence of the greater elevation of the Chapel and other adjacent buildings, the smoke of the vestry was, from the day of its erection, an insufferable nuisance. I am fully convinced that if chimneys were constructed according to your skilful plans, the general complaint of perpetual or occasional smoke would cease to be heard.

I must not omit mentioning, that your charge is considered extremely moderate.

I am, &c.

(Signed) ROBT. WILSON, *Chapel Steward.*

To George Silver, Aberdeen.

32.—*Extract from the Elgin Courier.*

SMOKY CHIMNEYS.

In our advertising columns will be found a notice on this subject from a smoke-doctor in Aberdeen. We freely confess, that for a long period we believed that in general the smoke arises from ill-constructed chimneys, or the eddy caused by higher houses in the neighbourhood, and we were very sceptical of the possibility of curing this abominable nuisance, without remodelling

the vent, or raising the chimney; but we are, at the same time, equally ready to attest, that some years ago a complete and permanent cure was, to our knowledge, and in the face of our declared scepticism, effected speedily, and by very simple means, by the same individual who now offers his services to the public through the medium of our columns.

N. B.—The author had an advertisement in the same number of the paper, which is referred to in this article.

NO. VI.

The following is copied from COUNT RUMFORD'S Treatise on the Cure of Smoking Chimneys, &c.

The plague of a smoking chimney is proverbial; but there are many other great defects in open fire-places, as they are now commonly constructed in this country, and indeed throughout Europe, which, being less obvious, are seldom attended to; and there are some of them very fatal in their consequences to health, and, I am persuaded, cost the lives of thousands every year in this island.

Those cold and chilling draughts of air on one side of the body, while the other side is scorched by a chimney fire, which every one who reads this must often have felt, cannot but be highly detrimental to health; and in weak and delicate constitutions must often produce the most fatal effects. I have not a doubt in my

own mind, that thousands die in this country every year of consumptions, occasioned solely by this cause. By a cause which might be so easily removed ; by a cause whose removal would tend to promote comfort and convenience in so many ways.

Strongly impressed as my mind is with the importance of this subject, it is not possible for me to remain silent. The subject is too nearly connected with many of the most essential enjoyments of life, not to be highly interesting to all those who feel pleasure in promoting or in contemplating the happiness of mankind. And without suffering myself to be deterred, either by the fear of being thought to give to the subject a degree of importance to which it is not entitled, or by the apprehension of being tiresome to my readers by the prolixity of my descriptions, I shall proceed to investigate the subject in all its parts and details with the utmost care and attention.

And first, with regard to smoking chimneys. There are various causes by which chimneys may be prevented from carrying smoke ; but there are none that may not easily be discovered, and completely removed. This will doubtless be considered as a bold assertion ; but I trust I shall be able to make it appear in a manner perfectly satisfactory to my readers, that I have not ventured to give this opinion but upon good and sufficient grounds.

Those who will take the trouble to consider the nature and properties of elastic fluids, of air, smoke, and vapour, and examine the laws of their motions, and the necessary consequences of their being rarefied by heat, will perceive that it would be as much a miracle if

smoke should not rise in a chimney, (all hinderances to its ascent being removed,) as that water should refuse to run in a siphon, or to descend in a river.

The whole mystery, therefore, of curing smoking chimneys is comprised in this simple direction : find out and remove those local hinderances which forcibly prevent the smoke from following its natural tendency to go up the chimney; or rather, to speak more accurately, which prevent its being forced up the chimney by the pressure of the heavier air of the room.

Although the causes by which the ascent of smoke in a chimney may be obstructed, are various, yet that cause which will most commonly, and I may say universally, be found to operate, is one which it is always very easy to discover, and as easy to remove—the bad construction of the chimney in the neighbourhood of the fire-place.

In the course of all my experience and practice in curing smoky chimneys, and I certainly have not had less than five hundred under my hands, and among them many which were thought to be quite incurable, I have never been obliged, except in one single instance, to have recourse to any other method of cure than merely reducing the fire-place and the throat of the chimney, or that part of it which lies immediately above the fire-place, to a proper form and just dimensions. That my principles for constructing fire-places are equally applicable to those which are designed for burning coal, as to those in which wood is burned, has lately been abundantly proved by experiments made here in London; for of above a hundred and fifty fire-places which have been altered in this city, under my direction, with-

in these last two months, there is not one which has not answered perfectly well ; and by several experiments, which have been made with great care, and with the assistance of thermometers, it has been demonstrated that the saving of fuel, arising from these improvements of fire-places, amounts in all cases to more than a half, and in many cases to more than two-thirds, of the quantity formerly consumed. Now, as the alteration in fire-places which are necessary may be made at a very trifling expense, as any kind of grate or stove may be made use of, and as no iron work, but merely a few bricks and some mortar, or a few small pieces of fire-stone, are required, the improvement in question is very important, when considered merely with a view to economy ; but it should be remembered, that not only a great saving is made of fuel by the alterations proposed, but that rooms are made much more comfortable and salubrious ; that they may be more equally warmed, and more easily kept at any required temperature ; that all draughts of cold air from doors and windows towards the fire-place, which are so fatal to delicate constitutions, will be completely prevented ; that in consequence of the air being equally warm all over the room, or in all parts of it, it may be entirely changed with the greatest facility, and the room completely ventilated, when this air is become unfit for respiration, and this merely by throwing open for a moment a door opening into some passage from whence fresh air may be had, and the upper part of a window ; or by opening the upper part of one window and the lower part of another. And as the operation of ventilating the room, even when it is done in the most complete manner, will never require

the door and window to be open more than one minute; in this short time the walls of the room will not be sensibly cooled, and the fresh air which comes into the room will, in a very few minutes, be so completely warmed by these walls, that the temperature of the room, though the air in it be perfectly changed, will be brought to be very nearly the same as it was before the ventilation.

Those who are acquainted with the principles of pneumatics, and know why the warm air in a room rushes out at an opening made for it at the top of a window when colder air from without is permitted to enter by the door, or by any other opening situated lower than the first, will see, that it would be quite impossible to ventilate a room in the complete and expeditious manner here described, where the air in a room is partially warmed, or hardly warmed at all, and where the walls of the room remote from the fire are constantly cold, which must always be the case where, in consequence of a strong current up the chimney, streams of cold air are continually coming in through all the crevices of the doors and windows, and flowing into the fire-place.

But although rooms, furnished with fire-places constructed upon the principles here recommended, may be easily and most effectually ventilated, (and this is certainly a circumstance in favour of the proposed improvements,) yet such total ventilations will very seldom, if ever, be necessary. As long as any fire is kept up in the room, there is so considerable a current of air up the chimney, notwithstanding all the reduction that can be made in the size of its throat, that the continual

change of air in the room, which this current occasions, will generally be found to be quite sufficient for keeping the air in the room sweet and wholesome ; and, indeed, in rooms in which there is no open fire-place, and consequently no current of air from the room setting up the chimney, which is the case in Germany, and all the northern parts of Europe, where rooms are heated by stoves, those fire-places opening without are not supplied with air necessary for the combustion of the fuel from the room ; and although in most of the rooms abroad which are so heated, the windows and doors are double, and both are closed in the most exact manner possible, by slips of paper pasted over the crevices, or by slips of list or fur, yet when these rooms are tolerably large, and when they are not very much crowded by company, nor filled with a great many burning lamps or candles, the air in them is seldom so much injured as to become oppressive or unwholesome ; and those who inhabit them show, by their ruddy countenances, as well as by every other sign of perfect health, that they suffer no inconvenience whatever from their closeness. There is frequently, it is true, an oppressiveness in the air of a room heated by a German stove, of which those who are not much accustomed to living in those rooms seldom fail to complain, and, indeed, with much reason ; but this oppressiveness does not arise from the air of the room being injured by respiration and perspiration of those who inhabit it ; it arises from a very different cause, from a fault in the construction of German stoves in general, but which may be easily and most completely remedied, as I shall show more fully in another place. In the mean time, I would just observe here,

with regard to these stoves, that as they are often made of iron, and as this metal is a very good conductor of heat, some part of the stove in contact with the air of the room becomes so hot as to calcine, or rather to roast, the dust which lights upon it, which never can fail to produce a very disagreeable effect on the air of the room; and even when the stove is constructed of pantiles or pottery ware, if any part of it in contact with the air of the room is suffered to become very hot, which seldom fails to be the case in German stoves constructed on the common principles, nearly the same effects will be found to be produced on the air as when the stove is made of iron, as I have very frequently had occasion to observe.

Though a room be closed in the most perfect manner possible, yet, as the quantity of air injured and rendered unfit for further use by the respiration of two or three persons in a few hours, is very small compared to the immense volume of air which a room of a moderate size contains; and as a large quantity of fresh air enters the room, and an equal quantity of the warm air of the room is driven out of it every time the door is opened, there is much less danger of the air of a room becoming unwholesome for the want of ventilation than has been generally imagined, particularly in cold weather, when all the different causes which conspire to change the air of warmed rooms act with increased power and effect.

Those who have any doubts respecting the very great change of air or ventilation which takes place each time the door of a warm room is opened in cold weather, need only set the door of such a room wide open for a moment, and hold two lighted candles in the

door-way, one near the top of the door, and the other near the bottom of it, the violence with which the flame of that above will be driven outwards, and that below inwards, by the two strong currents of air which, passing in opposite directions, rush in and out of the room at the same time, will be convinced that the change of air which actually takes place must be very considerable indeed, and that these currents will be stronger, and consequently the change of air greater, in proportion as the difference is greater between the temperatures of the air within the room and that without. I have been more particular upon this subject—the ventilation of warmed rooms which are constantly inhabited—as I know that people in general in this country have great apprehensions of the bad consequences to health of living in rooms in which there is not a continual influx of cold air from without. I am as much an advocate for a free circulation of air as any body, and always sleep in a bed without curtains on that account; but I am much inclined to think that the currents of cold air which never fail to be produced in rooms heated by fire-places constructed upon the common principle,—those partial heats on one side of the body and cold blasts on the other, so often felt in houses in this country, are infinitely more detrimental to health than the supposed closeness of the air in a room warmed more equally, and by a smaller fire.

All these advantages, attending the introduction of the improvements in fire-places, here recommended, are certainly important, and I do not know that they are counterbalanced by any one disadvantage whatsoever. The only complaint that I ever heard against them was,

that they made the rooms *too* warm; but the remedy to this evil is so perfectly simple and obvious, that I should be almost afraid to mention it, lest it might be considered as an insult to the understanding of the person to whom such information should be given; for nothing surely can be conceived more perfectly ridiculous than the embarrassment of a person on account of the too great heat of his room, when it is in his power to diminish *at pleasure* the fire by which it is warmed, and yet, strange as it may appear, this has sometimes happened.

Before I proceed to give directions for the construction of fire-places, it will be proper to examine more carefully the fire-places now in common use;—to point out their faults, and to establish the principles upon which fire-places ought to be constructed.

The great fault of all open fire-places, or chimneys, for burning wood or coals in an open fire, now in common use, is that they are much too large; or rather it is *the throat of the chimney*, or the lower part of its open canal, in the neighbourhood of the mantel and immediately over the fire, which is too large. This opening has hitherto been left larger than otherwise it probably would have been, in order to give passage to the chimney sweeper; but I shall show hereafter how a passage for the chimney sweeper may be contrived without leaving the throat of the chimney of such enormous dimensions as to swallow up and devour all the warm air in the room, instead of merely giving a passage to the smoke and heated vapour which rise from the fire, for which last purpose alone it ought to be destined.

Were it my intention to treat my subject in a formal,

scientific manner, it would doubtless be proper, and even necessary, to begin by explaining in the fullest manner, and upon principles founded on the laws of nature, relative to the motions of elastic fluids, as far as they have been discovered and demonstrated, the causes of the ascent of smoke, and also to explain and illustrate upon the same principles, and even to measure, or estimate by calculations, the precise effects of all those mechanical aids which may be proposed for assisting it in its ascent, or rather for removing those obstacles which hinder its motion upwards ;—but as it is my wish rather to write a useful, practical treatise, than a learned dissertation, being more desirous to contribute in diffusing useful knowledge, by which the comforts and enjoyments of mankind may be increased, than to acquire the reputation of a philosopher among learned men, I shall endeavour to write in such a manner as to be easily understood *by those who are most likely to profit by the information I have to communicate*, and consequently most likely to assist in bringing into general use the improvements I recommend. This being premised, I shall proceed without any farther preface or introduction to the investigation of the subject I have undertaken to treat.

As the immoderate size of the throat of chimneys is the great fault of their construction, it is this fault which ought always to be first attended to in every attempt which is made to improve them ; for, however, perfect the construction of a fire-place may be in other respects, if the opening left for the passage of the smoke is larger than is necessary for that purpose, nothing can prevent the warm air of the room from escaping through it, and

whenever this happens, there is not only an unnecessary loss of heat, but the warm air which leaves the room to go up the chimney being replaced by cold air from without, the draughts of cold air, so often mentioned, cannot fail to be produced in the room, to the great annoyance of those who inhabit it. But although both these evils may be effectually remedied by reducing the throat of the chimney to a proper size, yet in doing this several precautions will be necessary. And first of all, the throat of the chimney should be in its proper place; that is to say, in that place in which it ought to be in order that the ascent of the smoke may be most facilitated; for every means which can be employed for facilitating the ascent of the smoke in the chimney must naturally tend to prevent the chimney from smoking; now as the smoke and hot vapour which rise from a fire naturally tend upwards, the proper place for the throat of the chimney is evidently perpendicularly over the fire.

But there is another circumstance to be attended to in determining the proper place for the throat of a chimney, and that is, to ascertain its distance from the fire, or how far above the burning fuel it ought to be placed. In determining this point there are many things to be considered, and several advantages and disadvantages to be weighed and balanced.

As the smoke and vapour which ascend from burning fuel rise in consequence of their being rarefied by heat, and lighter than the air of the surrounding atmosphere; and as the degree of their rarefaction, and consequently their tendency to rise, is in proportion to the intensity of their heat; and farther, as they are hotter

near the fire than at a greater distance from it, it is clear that the nearer the throat of a chimney is to the fire the stronger will be, what is commonly called, its *draught*, and the less danger there will be of its smoking. But on the other hand, when the draught of a chimney is very strong, and particularly when this strong draught is occasioned by the throat of the chimney being very near the fire, it may so happen that the draught of air into the fire may become so strong, as to cause the fuel to be consumed too rapidly. There are likewise several other inconveniences which would attend the placing of the throat of a chimney very near the burning fuel.

In introducing the improvements proposed in chimneys already built, there can be no question in regard to the height of the throat of the chimney, for its place will be determined by the height of the mantel. It can hardly be made lower than the mantel, and ought always to be brought down as nearly upon the level with the bottom of it as possible. If the chimney is apt to smoke, it will sometimes be necessary either to lower the mantel, or to diminish the height of the opening of the fire-place by throwing over a flat arch, or putting in a straight piece of stone from one side to the other, or, which will be still more simple and easy in practice, building a wall of bricks, supported by a flat bar of iron immediately under the mantel.

Nothing is so effectual to prevent chimneys from smoking as diminishing the opening of the fire-place in the manner here described, and lowering and diminishing the throat of the chimney; and I have always found, except in the single instance already mentioned, that a perfect cure may be effected by *these means alone*, even in

the most desperate cases. It is true, that when the construction of the chimney is very bad indeed, or its situation very unfavourable to the ascent of the smoke, and especially when both these disadvantages exist at the same time, it may sometimes be necessary to diminish the opening of the fire-place, and particularly to lower the throat of the chimney, more than might be wished; but still I think this can produce no inconveniences to be compared with that greatest of all plagues, a smoking chimney.

The position of the throat of a chimney being determined, the next points are its size and form, and the manner in which it ought to be connected with the fire-place below, and with the open canal of the chimney above.

But as these investigations are intimately connected with those which relate to the forms proper to be given to the fire-place itself, we must consider them altogether.

That these inquiries may be pursued with due method, and that the conclusion drawn from them may be clear and satisfactory, it will be necessary to consider first what the objects are which ought principally to be had in view in the construction of a fire-place; and secondly, to see how these objects can be best obtained.

Now the design of a chimney fire being simply to warm a room, it is necessary first of all to contrive matters so that the room shall be actually warmed; secondly, that it be warmed with the smallest expense of fuel possible; and, thirdly, that in warming it, the air of the room be preserved perfectly pure, and fit for respiration, and free from smoke and all disagreeable smells.

In order to take measures with certainty for warming

a room by means of an open chimney fire, it will be necessary to consider *how*, or in what manner, such a fire communicates heat to a room. This question may perhaps, at the first view of it, appear superfluous and trifling, but a more careful examination of the matter will show it to be highly deserving of the most attentive investigation.

To determine in what manner a room is heated by an open chimney fire, it will be necessary first of all to find out, *under what form* the heat generated in the combustion of the fuel exists, and then to see how it is communicated to those bodies which are heated by it.

In regard to the first of these subjects of inquiry, it is quite certain that the heat which is generated in the combustion of the fuel exists under two perfectly distinct and very different forms. One part of it is *combined* with the smoke, vapour, and heated air which rise from the burning fuel, and goes off with them into the upper regions of the atmosphere, while the other part, which appears to be *uncombined*, or, as some ingenious philosophers have supposed, combined only with light, is sent off from the fire in rays in all possible directions.

With respect to the second subject of inquiry, namely, how this heat, existing under these two different forms, is communicated to other bodies; it is highly probable that the combined heat can only be communicated to other bodies by *actual contact* with the body with which it is combined; and with regard to the rays which are sent off by burning fuel, it is certain that they communicate or generate heat only *when* and *where* they are stopped or absorbed. In passing through air, which is transparent, they certainly do not communicate any

heat to it: and it seems highly probable that they do not communicate heat to solid bodies by which they are reflected.

In these respects they seem to bear a great resemblance to the solar rays. But in order not to distract the attention of my reader, or carry him too far away from the subject more immediately under consideration, I must not enter too deeply into these inquiries respecting the nature and properties of what has been called *radiant heat*. It is certainly a most curious subject of philosophical investigation, but more time would be required to do it justice than we now have to spare. We must therefore content ourselves with such a partial examination of it as will be sufficient for our present purpose.

A question which naturally presents itself here is, what proportion does the radiant heat bear to the combined heat? Though that point has not yet been determined with any considerable degree of precision, it is, however, quite certain that the quantity of heat which goes off, combined with the smoke, vapour, and heated air, is much more considerable, perhaps three or four times greater at least, than that which is sent off from the fire in rays. And yet, small as the quantity is of this radiant heat, it is the only part of the heat generated in the combustion of fuel burnt in an open fireplace which is ever employed, or which can ever be employed, in heating a room.

The whole of the combined heat escapes by the chimney, and is totally lost, and, indeed, no part of it could ever be brought into a room from an open fireplace, without bringing along with it the smoke with

which it is combined; which, of course, would render it impossible for the room to be inhabited. There is, however, one method by which combined heat, and even that which arises from an open fire-place, may be made to assist in warming a room; and that is by making it pass through something analogous to a German stove, placed in the chimney above the fire. But of this contrivance I shall take occasion to treat more fully hereafter; in the mean time I shall continue to investigate the properties of open chimney fire-places, constructed upon the most simple principles, such as are now in common use; and shall endeavour to point out and explain all those improvements of which they appear to me to be capable.

When fuel is burnt in fire-places upon this simple construction, where the smoke escapes immediately by the open canal of the chimney, it is quite evident that all the combined heat must of necessity be lost; and as it is the radiant heat alone which can be employed in heating a room, it becomes an object of much importance to determine how the greatest quantity of it may be generated in the combustion of the fuel, and how the greatest proportion possible of that generated may be brought into the room.

Now the quantity of radiant heat generated in the combustion of a given quantity of any kind of fuel depends very much upon the management of the fire, or upon the manner in which the fuel is consumed. When the fire burns bright, much radiant heat will be sent off from it, but when it is *smothered* up, very little will be generated; and indeed very little combined heat, that can be employed to any useful purpose; most of the heat

produced will be immediately *expended* in giving elasticity to a thick dense vapour or smoke which will be seen rising from the fire;—and the combustion being very incomplete, a great part of the inflammable matter of the fuel being merely rarefied and driven up the chimney without being inflamed, the fuel will be wasted to little purpose. And hence it appears of how much importance it is, whether it be considered with a view to economy, or to cleanliness, comfort, and elegance, to pay due attention to the management of a chimney fire.

Nothing can be more perfectly void of common sense, and wasteful and slovenly at the same time, than the manner in which chimney fires, and particularly where coal are burned, are commonly managed by servants. They throw on a load of coals at once, through which the flame is hours in making its way; and frequently it is not without much trouble that the fire is prevented from going quite out. During this time no heat is communicated to the room; and what is still worse, the throat of the chimney being occupied merely by a heavy dense vapour, not possessed of any considerable degree of heat, and consequently not having much elasticity, the warm air of the room finds less difficulty in forcing its way up the chimney and escaping, than when the fire burns bright;—and it happens not unfrequently, especially in chimneys and fire-places ill constructed, that this current of warm air from the room which presses into the chimney, crossing upon the current of heavy smoke which rises slowly from the fire, obstructs it in its ascent, and beats it back into the room; hence it is that chimneys so often smoke when too large a quantity of fresh coals is put upon the fire. So many

coals should never be put upon the fire at once as to prevent the free passage of the flame between them. In short, a fire should never be smothered; and when proper attention is paid to the quantity of coals put on, there will be very little use for the poker; and this circumstance will contribute very much to cleanliness; and to the preservation of furniture.

Those who have feeling enough to be made miserable, by any thing careless, slovenly, and wasteful which happens under their eyes, who know what comfort is, and consequently are worthy of the enjoyments of a *clean hearth* and a *cheerful fire*, should really either take the trouble themselves to manage their fires, (which indeed would rather be an amusement to them than a trouble,) or they should instruct their servants to manage them better.

But to return to the subject more immediately under consideration, as we have seen what is necessary to the production or generation of radiant heat; it remains to determine how the greatest proportion of that generated and sent off from the fire in all directions may be made to enter the room, and assist in warming it. Now as the rays which are thrown off from burning fuel have this property in common with light, that they generate heat only *when* and *where* they are stopped or absorbed, and also in being capable of being reflected *without generating heat* at the surfaces of various bodies, the knowledge of these properties will enable us to take measures, with the utmost certainty, for producing the effect required, that is to say, for bringing as much radiant heat as possible into the room.

This must be done, first by causing as many as pos-

sible of the rays, as they are sent off from the fire in straight lines, to come *directly* into the room, which can only be effected by bringing the fire as far forward as possible, and leaving the opening of the fire-place as wide and as high as can be done without inconvenience; and secondly, by making the sides and back of the fire-place of such form, and constructing them of such materials as to cause the direct rays from the fire, which strike against them, to be sent into the room by reflection in the greatest abundance.

Now it will be found, upon examination, that the best form for the vertical sides of a fire-place, or the *coverings* as they are called, is that of an upright plane, making an angle with the plane of the back of the fire-place, of about 135 degrees. According to the present construction of chimneys this angle is 90 degrees, or forms a right angle; but as in this case the two sides or coverings of the fire-place are parallel to each other, it is evident that they are very ill contrived for throwing into the room by reflection the rays from the fire which fall on them.

To have a clear and perfect idea of the alterations I propose in the forms of fire-places, the reader need only observe, that, whereas the backs of fire-places, as they are now commonly constructed, are as wide as the opening of the fire-place in front, and the sides of it are of course perpendicular to it, and parallel to each other; in the fire-places I recommend, the back is only about one-third of the width of the opening of the fire-place in front, and consequently the two sides or coverings of the fire-place, instead of being perpendicular to the back, are inclined to it at an angle of about 135 degrees;

and in consequence of this position, instead of being parallel to each other, each of them presents an oblique front towards the opening of the chimney, by means of which the rays which they reflect are thrown into the room.

In regard to the materials which it will be most advantageous to employ in the construction of fire-places, so much light has, I flatter myself, already been thrown on the subject we are investigating, and the principles adopted have been established on such clear and obvious facts, that no great difficulty will attend the determination of that point. As the object in view is to bring radiant heat into the room, it is clear that that material is best for the construction of a fire-place which reflects the most, or which absorbs the least of it ; for that heat which is *absorbed* cannot be reflected. Now as bodies which absorb radiant heat are necessarily heated in consequence of that absorption, to discover which of the various materials that can be employed for constructing fire-places are best adapted for that purpose, we have only to find out by an experiment, very easy to be made, what bodies acquire *least heat* when exposed to the direct rays of a clear fire; for those which are least heated, evidently absorb the least, and consequently reflect the most radiant heat. And hence it appears that iron, and, in general, metals of all kinds, which are well known to *grow very hot* when exposed to the rays projected by burning fuel, are to be reckoned among the *very worst* materials which it is possible to employ in the construction of fire-places.

The best materials I have hitherto been able to discover are fire stone, and common bricks and mortar.

Both these materials are, fortunately, very cheap; and as to their comparative merits, I hardly know to which of them the preference ought to be given.

When bricks are used they should be covered with a thin coating of plaster, which, when it is become perfectly dry, should be white-washed. The fire stone should likewise be white-washed, when that is used; and every part of the fire-place which is not exposed to being soiled and made black by the smoke, should be kept as white and clean as possible. As *white* reflects more heat, as well as more light than any other colour, it ought always to be preferred for the inside of a chimney fire-place, and *black*, which reflects neither light nor heat, should be most avoided.

I am well aware how much the opinion I have ventured to give, respecting the unfitness of iron and other metals to be employed in the construction of open fire-places, differs from the opinion generally received upon that subject;—and I even know that the very reason which, according to my ideas of the matter, renders them totally unfit for the purpose, is commonly assigned for making use of them; namely, that they soon grow very hot. But I beg leave to ask what advantage is derived from heating them?

I have shown the disadvantage of it, namely, that the quantity of radiant heat thrown into the room is diminished; and it is easy to show that almost the whole of that absorbed by the metal is ultimately carried up the chimney by the air, which coming into contact with this hot metal, is heated and rarefied by it, and forcing its way upwards, goes off with the smoke; and as no current of air ever sets from any part of the opening of

a fire-place into the room, it is impossible to conceive how the heat existing in the metal composing any part of the apparatus of the fire-place, and situated within its cavity, can come, or be brought into the room. This difficulty may be in part removed by supposing, what indeed seems to be true in a certain degree, that the heated metal sends off in rays the heat it acquires from the fire, even when it is not heated red-hot; but still, as it never can be admitted that the heat absorbed by the metal and afterwards thrown off by it in rays, is *increased* by this operation, nothing can be gained by it; and as much necessarily must be lost, in consequence of the great quantity of heat communicated by the hot metal to the air in contact with it, which, as, has already been shown, always makes its way up the chimney and flies off into the atmosphere, the loss of heat attending the use of it is too evident to require being farther insisted on.

There is, however, in chimney fire-places destined for burning coals, one essential part, the grate, which cannot well be made of anything else but iron; but there is no necessity whatever for that immense quantity of iron which surrounds grates as they are now commonly constructed and fitted up, and which not only renders them very expensive, but injures very essentially the fire-place. If it should be necessary to diminish the opening of a large chimney in order to prevent its smoking, it is much more simple, economical, and better in all respects, to do this with marble, fire stone, or even with bricks and mortar, than to make use of iron, which, as has already been shown, is the very worst material that can possibly be employed for that purpose;

and as to register grates, they not only are quite unnecessary, where the throat of a chimney is properly constructed, and of proper dimensions, but in that case would do much harm. If they act at all, it must be by opposing their flat surfaces to the current of rising smoke in a manner which cannot fail to embarrass and impede its motion. But we have shown that the passage of the smoke through the throat of a chimney ought to be facilitated as much as possible, in order that it may be enabled to pass by a small aperture.

Register stoves have been often found to be of use, but it is because the great fault of all fire-places constructed upon the common principles being the enormous dimensions of the throat of the chimney ; this fault has been in some measure corrected by them ; but I will venture to affirm, that there never was a fire-place so corrected that would not have been much more improved, and with infinitely less expense, by the alterations here recommended, and which will be more particularly explained in the next chapter.

A good kitchen range should possess the following indispensable qualifications :—it should require little fuel in cooking ; should be able to roast, boil, and dress a number of dishes at the same time ; and should at all times by night and by day, possess plenty of hot water. At one end is an oven for baking, and at the other a boiler ; in the centre is a fire-place, measuring fifteen inches in length ; the oven is heated not by a separately kindled fire, but by some of the burning embers being pushed in below it from the central fire-place. The central fire also heats and keeps boiling the water in the boiler.

This boiler has more than one side presented to the fire ; it extends all round the back of the fire-place like a square tube, presenting a large surface to the fire ; and the water is therefore kept hot even when a very small quantity of fuel is in the grate. The top of the boiler at side and back, and also the oven, are perfectly flat, so that the whole upper surface answers the purpose of a hot plate. I have said the fire-place is fifteen inches in length, but this extent can be diminished by a movable division and hole. From beneath the grate, a grated shelf can be pulled out to rest dishes upon. Thus the whole is of a compact nature, full of conveniences. Such a grate roasts meat in front, bakes a dish in the oven, boils a sauce-pan on the fire, keeps simmering at least other three vessels all at the same time, while the fire employed is only about half what is usually consumed in large unthrifty grates in common use in this country. Besides furthering those various operations, the boiler has always a store of hot water.











